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MVP Definition Data on Demand

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1 Abstract

This document defines the functional requirements for a DLT-based Businessbusiness and operations support system for on-demand data services. The document defines an abstract reference architecture and abstract workflows for the following service lifecycle steps: inquiry, quote, order, delivery, SOAM, billing, consolidation and settlement. This document enhances the LSO Reference Architecture defined in MEF-55 by adding commercial and operational layers and an abstract process workflow. For a business overview of ‘on-demand data services,’ refer to the whitepaper (see Appendix A herewith) on the subject, especially as a useful introduction/pre-read to this document.

2 Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other CBAN or external documents. In addition, terms defined in other CBAN publications are included in this document by reference and are not repeated in the table below.

Term	Description	Notes	Reference
AML	Anti-Money Laundering	When entities within the CBAN need to exchange sensitive data and financial transactions, it is important that they comply with AML/KYC regulations to protect themselves against money laundering, terrorist financing and transfer of funds. See also [4]	This document
BC	Bilateral ledger ‘Customer’	Repositories containing information that is shared with the Buyer ICT-SP	This document

Term	Description	Notes	Reference
Bilateral agreements	The business relationship between two ICTs. The relationship between these ICTs is always bilateral, on a one-on-one level.	A service may span across multiple ICT-SPs but is implemented through a chain (that may be forked and forked again) of bilateral relations between pairs of ICT-SPs.	This document
Bilateral business process	The various business processes that are part of the bilateral agreement. Includes quote, markup, order, billing, reconciliation and settlement.		This document
Bilateral Ledger	A Ledger shared between exactly two parties.		This document.
Billing	The process in which the Payee invoices the Payer for the amount stipulated by the agreement and based on utilization information and SLA or other credits as applicable based on agreement.	Billing is expressed in currency, FIAT or Stable token as agreed by both parties	MEF 74 [3]
BS	Bilateral ledger ‘Supplier’	Those repositories contain information that is shared with the Supplier ICT-SP	This document
BSS layer	A system or a collection of systems that include the components that an ICT-SP uses to run its business operations towards its customers. Together with an operations support system (OSS), they are used to support various end-to-end telecommunication services. The two systems together are often abbreviated OSS/BSS, BSS/OSS or simply B/OSS.		MEF reference Wiki [2]

Term	Description	Notes	Reference
CBAN Association	A collaborative entity consisting of members of multiple companies involved in the ICT-SP space, including ICT-SPs, vendors, financial institutions and advisors.	At the time this document is published CBAN is formalizing the CBAN Association, which may result in a name change and a detailed definition of its modus operandi.	This document
Change Management	Changes made to in-operation service instances.		This document
Commercial framework	A framework that demonstrates the generation of commercial value through wholesale trading of data services		This document
Credit Allocation	The amount of monetary funds that a buyer can consume prior to making payment to seller. This is typically derived from Credit Score and Payment History.	Example: The customer has been allocated a USD 5000 credit.	MEF 74 [3]
Credit Score	The amount of confidence a seller has with the buyer to pay their bills.	Example: The customer has missed the due date an average of one out of 4 of its last payments thus it has been given a credit score of 75%.	MEF 74 [3]
Data Measurement Unit	An abstract definition of data as a string of bits or Bytes.	Measuring different types of data allows for data to be quantified and billed in currencyfinancial terms.	MEF 74 [3]
Data on-demand	Data on demand services are expected to be activated, operated, billed and settled with immediate effect.	This expectation is based on pre-existing and pre-on-boarded facilities and interconnects	

Term	**Description**	**Notes**	**Reference**
Deposit	An amount pre-paid by the buyer to the seller prior to consuming services.	This is typically derived by multiplying the [Recurring Selling Price (in the event of a fixed recurring amount) or the estimated recurring amount to be billed (in the case of usage-based recurring amount)] by the Payment History.	MEF 74 [3]
DLT	Distributed Ledger Technology. A digital system for recording information so it is recorded in multiple places at the same time.		University of Cambridge [5]
Entity ID	An ID assigned to an entity by official repositories that exist in certain countries/continents		MEF 74 [3]
Identity	A database assigned to one single task which collects information	Can be a route, entity, asset, contract. Unverified or verified data. Could be collecting contracts, routes, entityentity, payment etc.. There is no limit to identity, it just comes down to what information needs/wants to be collected.	This document
IN	Internal ledger	repositoriesRepositories that contain information that will be used internally be an ICT-SP and does not need to be shared with any other external entity.	This document
Inquiry and Quote	Service lifecycle phases during which an inquiry is made by a customer to potential suppliers seeking availability and pricing of certain network services.	Service details include: Locations, Bandwidth, QoS, VNF details (CPU, OS, RAM, Storage…)	This document

Term	Description	Notes	Reference
IRP	Interface Reference Point		MEF 55 [6]
KYC	Know Your Customer	When entities within the CBAN need to exchange sensitive data and financial transactions, it is important that they comply with AML/KYC regulations to protect themselves against money laundering, terrorist financing and transfer of funds.	This document
LSO	Lifecycle Service Orchestration	Open and interoperable automation of management operations over the entire lifecycle of Layer 2 and Layer 3 Connectivity Services. This includes fulfillment, control, performance, assurance, usage, security, analytics and policy capabilities, over all the network domains that require coordinated management and control in order to deliver the service.	MEF 55 [6]
LSO reference architecture	A layered abstraction architecture that characterizes the management and control domains and entities, and the interfaces among them, to enable cooperative orchestration of Connectivity Services.		MEF 55 [6]
MEF 52	Defines the framework by which performance monitoring and reporting is performed for services delivered on a multi-domain environment.		MEF 52 [7]

Term	Description	Notes	Reference
MEF 74	Defines methods of measurement of data services and methods of measuring performance and applying credits based on deviation of performance from SLA targets.		MEF 74 [3]
Multi-domain automated telco supply-chain	See 'Bilateral agreements'		This document
Multilateral	A relation that includes two or more parties.		This document
Multilateral Agreement / Multilateral Contract	An agreement or contract that includes two or more parties.		This document
Multilateral Ledger	A ledger shared between two or more parties.		This document
Mutual-suspicion and coopetition	Where ICT-SPs both compete and cooperate with each other within the wholesale space.	On one hand ICT-SPs compete with each other by trying to win the consumer or wholesale business. On the other hand, ICT-SPs often rely on complementing their own portfolio with certain elements of service that they acquire from their competitors. This could be geographical coverage of a certain territory, compute or storage resources or specific applications or security features not available through the ICT-SP's own resources.	This document
NFV	Network Function Visualization		ETSI GS NFV-IFA 011 V3.3.1 (2019-09) [8]
Omni	A short name for an Omnilateral ledger	Origin of the term is the Latin word *omnis* that means "All".	This document

Term	**Description**	**Notes**	**Reference**
Omnilateral Ledger	Repositories that contain information which is shared with a larger group of ICT-SPs, potentially all ICT-SP participants of CBAN		This Document
Ordering	Service lifecycle phase where a customer is placing an order for a service with a suppler based on a quote received either through an inquiry/quote phase or based on a valid cost-book.		This document
OSS layer	A term used to describe the information processing systems used by operators to orchestrate and manage their communications networks.	It allows an organization to coordinate resources, processes and activities. They assist operators to design, build, operate and maintain communications networks. Traditionally, OSS tend to provide network-facing or network-operations-facing functionality. This includes fault and performance management (assurance), customer activations (fulfillment), configuration management, network security and so much more.	MEF reference Wiki [9]
Payee/Receiver	An entity that request and/or receives a payment from another entity.		MEF 74 [3]
Payer	An entity that pays or is requested to make a payment to another entity.	This will typically be the same entity as the Buyer, though "Buy/Sell" typically refers to Services and Products while "Pay/Receive" typically refers to monetary exchange.	MEF 74 [3]

Term	Description	Notes	Reference
Payment	Transfer of monetary funds from Payer to Payee. A Payment may cover multiple Services or Products.		MEF 74 [3]
Payment History/Payment Record/Payment cycle time	The duration from forwarding an invoice from seller to buyer until payment of same is received by the seller.	Example: Payment was received an average of 45 days after invoice date.	MEF 74 [3]
Payment reputation	A metric representing the payment history of an ICT-SP including punctuality and accuracy of payments.		This document
Product catalogs	A ledger listing the products an ICT-SP can deliver.	Product availability may vary depending on location and magnitude.	This document
Provisioning	A phase in the lifecycle of a service during which an order is fulfilled and implemented on the respective network components.		This document
Reconciliation	The process of reaching agreement in case of a dispute.		MEF 74 [3]
SDN	Software Defined Network		ONF [10]
Service chaining	The process of configuring and integrating multiple service elements to become a single composite service.		IETF RFC-7665 [11]

Term	Description	Notes	Reference
Settlement	The transfer of monetary funds between parties based on billing and reconciliation	The process of analyzing the amount a Payer is invoiced by the Payee, comparing the resource usage and the monetary amounts associated with use of the resource as per commercial agreement, identifying the differences between the Payee's records and calculations to those of the payer. The differences may be settled either automatically or manually through algorithms.	MEF 74 [3]
SLA	The contract between the Subscriber and Service Provider specifying the service level commitments and related business agreements for a service		MEF 10.4 [12]
SLA reputation	A metric representing the ongoing performance of an ICT-SP network against its Service-Level commitments.	The reputation is a score based on a moving average.	This document
SOAM (Service Operations and Maintenance)	Service Operations, Administration and Maintenance		MEF 17 [13]
Sonata IRP	An IRP through which two ICT-SPs or a customer and an ICT-SP exchange commercial and operation information pertaining to services.	The implementation of the Sonata IRP in this document as described in Chapter 5 herewith deviates from the MEF LSO definition of Sonata.	MEF 3.0 [14]

Term	Description	Notes	Reference
Stable coin	Stable coins use Block-chain/DLT to transfer fee value, however their value is pegged to another stable asset (i.e.g. 1 stable token is equal to US$1)	Not to be confused with Crypto currency, which often lives on open ex-changes and is subject to volatility. Can be used in the settlement phase (pay-ment finality) or in any other appropriate area of an agreed contract in transferring one sum from one entity to another.	This document

Table 1 – Terminology and Abbreviations

3 Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**NOT RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in BCP 14 (RFC 2119 [15], RFC 8174 [16]) when, and only when, they appear in all capitals, as shown here. All key words must be in bold text.

Items that are **REQUIRED** (contain the words **MUST** or **MUST NOT**) are labeled as **[Rx]** for required. Items that are **RECOMMENDED** (contain the words **SHOULD** or **SHOULD NOT**) are labeled as **[Dx]** for desirable. Items that are **OPTIONAL** (contain the words **MAY** or **OPTIONAL**) are labeled as **[Ox]** for optional**.**

Editor Note 1: The following paragraph will be deleted if no conditional requirements are used in the document.

A paragraph preceded by **[CRa]<** specifies a conditional mandatory requirement that **MUST** be followed if the condition(s) following the “<” have been met. For example, “**[CR1]<**[D38]” indicates that Conditional Mandatory Requirement 1 must be followed if Desirable Requirement 38 has been met. A paragraph preceded by **[CDb]<** specifies a Conditional Desirable Requirement that **SHOULD** be followed if the condition(s) following the “<” have been met. A paragraph preceded by **[COc]<** specifies a Conditional Optional Requirement that **MAY** be followed if the condition(s) following the “<” have been met.

4 Numerical Prefix Conventions

Editor Note 2: This section will be deleted if no numerical prefixes are used in the document.

This document uses the prefix notation to indicate multiplier values as shown in Table 2.

Decimal		**Binary**	
Symbol	**Value**	**Symbol**	**Value**
k	10^3	Ki	2^{10}
M	10^6	Mi	2^{20}
G	10^9	Gi	2^{30}
T	10^{12}	Ti	2^{40}
P	10^{15}	Pi	2^{50}
E	10^{18}	Ei	2^{60}
Z	10^{21}	Zi	2^{70}
Y	10^{24}	Yi	2^{80}

Table 2 – Numerical Prefix Conventions

5 Introduction

ICT-SPs handle data in multiple forms, such as transport, storage and processing. Applications, such as content distributions, mobile apps, e-mail exchange, offered by ICT-SPs and others use a mix of same.

The document will focus on a Commercial and Operational framework (agnostic to service type/technology) demonstrating generation of commercial value through wholesale trading of data services. The document defines an abstract architecture that refers to a single ICT-SP, however each ICT-SP must be considered in the context of being one link in an automated supply-chain of multiple ICT-SPs, jointly delivering the end-to-end service to the consumers..

ICT-SPs operate in a state of *mutual-suspicion* and in an environment of "*coopetition*" where ICT-SPs **both compete and cooperate** with each other. Management of such supply chain in an environment of mutual-suspicion and coopetition eliminates the option of using a centralized intermediator.

The current ICT-SP environment consists of operational silos interconnected through a partial mesh of physical and logical interfaces. The physical interfaces are named "E-NNI", which stands for an External Network to Network Interface. That is the interface through which the data flows between one ICT-SP to another. The logical interfaces are named "Sonata", following the MEF LSO Reference Architecture that has named the Business-to-Business IRP (Interface Reference Point) after a musical term, hinting for its relation to Orchestration of services. That is the interface through which the commercial and operational information flows between the Business and Orchestration layers of said ICT-SPs.

While automation of intra-silo/intra-ICT-SP activity already exists in certain ICT-SPs, automation of inter-silo/inter-ICT-SP activities is still handled primarily manually. Automation is focused primarily on internal processes, and little or no attention had been given to automation of inter-SP operations. This leads to long lead times for delivery of services, long time to market and inability to cater to services that require short lead times. Services that could yield new revenue streams from existing infrastructure. Through automation of Service LifecycleLifecycle, ICT-SPs can benefit from ***Cost reduction, Acceleration*** and ***New Revenue Streams***.

The document is divided into three main sections:

- High-level Functional Requirements from a system that enables the above.
- Abstract workflows that describe the intra-ICT-SP and inter-ICT-SP processes for each service lifecycle stage.
- A tabular representation of the information that flows between the entities at each stage and where it is stored.

The document has identified three types of ledgers:

- Internal (used by a single ICT-SP)
- Bilateral (used by a pair of ICP-SPs that share an E-NNI and a Sonata IRP)

- Multilateral (Shared between a group larger than two of ICT-SPs) and aims to be consistent with the CBAN Reference Architecture published by CBAN.

6 High Level Functional Requirements

The solution streamlines commercial and operational functionalities within an ICT-SP in a manner that can be linked/cascaded across a supply chain of ICT-SPs.

6.1 The solution must:

1. Support bilateral business processes (quote, markup, order, SOAM, billing, reconciliation, settlement) through the MEF Sonata IRP.
2. Support internal ICT-SP technology process - agnostic to service type (catalogs of inventory, product catalogs, service chaining…)
3. Support the sharing of information across the CBAN Association (SLA reputation, payment reputation)
4. Allow co-existence and interoperability with legacy platforms on a per ICT-SP basis.

6.2 The approach requires:

1. Abstraction of functional entities (e.g. purchasing entity, selling entity, orchestration entity, catalogue).
2. Abstraction of business-service Service Lifecycle (e.g. Inquiry, Ordering, Provisioning, SOAM, Billing, Change management).
3. Establishing agreed upon interface reference points (IRPs) between functional entities (following MEF-Sonata specs where applicable) in accordance with the CBAN Association mandated business-service discovery, negotiation and execution framework.
4. Each IRP is used for both inbound and outbound (buy and sell) purposes.
5. Each ICT-SP will have an Inbound/Outbound IRP implemented with each other ICT-SP with which it has commercial and operational relations (in the form of an E-NNI and a Master Service Agreement). This IRP is similar in nature and functionality to MEF-55 "Sonata" IRP, but also includes the functionality of "Cantata" and "Interlude" leaving a single IRP for all external communications between an ICT-SP and its neighbor, multiplied by the number of neighbors.
6. Establishing abstract workflows within the functional entities for each step in the lifecycle of a service.
7. Abstraction of applications developed by different vendors that fulfil the same functionality in a manner that will allow interoperability of the MVP elements of the application regardless of the vendor supplying that application.
8. For each application fulfilling the requirement defined in bullet #7 above - support of East-West interoperability with applications developed by other vendors.
9. Abstraction of the DLT layer in a manner that allows the MVP elements of any application to operate with any certified (certification is planned to be defined in the foreseeable future) underlying ledger. (this requirement is deferred to Phase 2).

6.3 The abstract workflows must

1. Be identical across all ICT-SPs in a supply chain.
2. Use the IRPs to exchange information between functional entities.
3. Use the same IRP to respond to a request coming from a neighbor through which such request has arrived.
4. Prevent loopback situations where an entity that has requested an element of service from another entity is being requested to provide that same element.
5. Provide an anonymous hop-count where each entity in the hop-count knows only the identities of its immediate neighbors.

6.4 The relations between Orders, Elements, Billing and Credits:

1. Orders can be broken down to elements and sub-elements (and subsequent levels below it down to atomic level). Certain elements may be linked/contingent. (e.g. a customer site and an on-site firewall can be represented as two different elements but may be grouped together representing the fact that they must be quoted and delivered as one).
2. Billing can be grouped on a per order basis or detailed on an element or sub element level. This is at the discretion of the buyer and seller and subject to a mutually agreed upon contract.
3. SLA credits can be per order or per element or sub element. This is at the discretion of the buyer and seller and subject to a mutually agreed upon contract.

6.5 Requirements from the DLT and DLT-abstraction layers

The DLT layer must:

1. Support bilateral contracts and be able to transact bilateral transactions at rates of up to 100 *[?]* per second.
2. Support multilateral contracts, which may be constructed of multiple chains that are synched in a manner that provides accuracy down to 15-minute intervals and must support the following reputation management requirements:
    1. SLA reputation, on a per MVP by ICT-SP basis, as defined in section 8.2.4.3 (Defining the SLA Reputation).
    2. Payment and financial stability reputation on a per ICT-SP, as defined in section 8.2.5.4 (Defining payment and financial stability reputation).

Mandatory Requirement 1 - The DLT Layer MUST support Bilateral Contracts.

Mandatory Requirement 2 - The DLT Layer MUST be able to transact bilateral transactions at a rate of 100 transactions per second or higher.

The DLT-Abstraction layer must:

1. Ensure MVP Applications are agnostic to the underlaying DLT (deferred to future phases).

6.6 Abstraction and Functional Elements

The following diagram represents the required abstraction levels between functional elements, where MVP(X/Y) represent data-on-demand applications such as E-Line, Videoconference etc.:

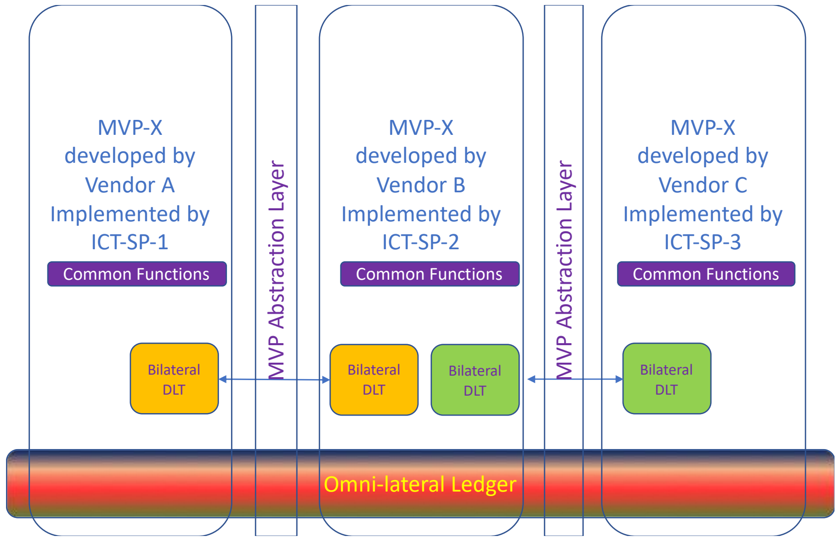


Figure 6-1 - MVP Abstraction Architecture - Phase 1

During Phase 1 vendors will provide the full stack (MVP, Common Functions, DLT) and offer support of a minimum of two DLT types.

During Phase 2 the stack will be further refined, allowing vendors to deliver MVPs, Common Functions and Ledger compatibility separate from each other as well as abstract elements from within the MVPs. This approach opens the eco-system to additional vendors specializing in specific layers of the stack or specific functions within the workflows.

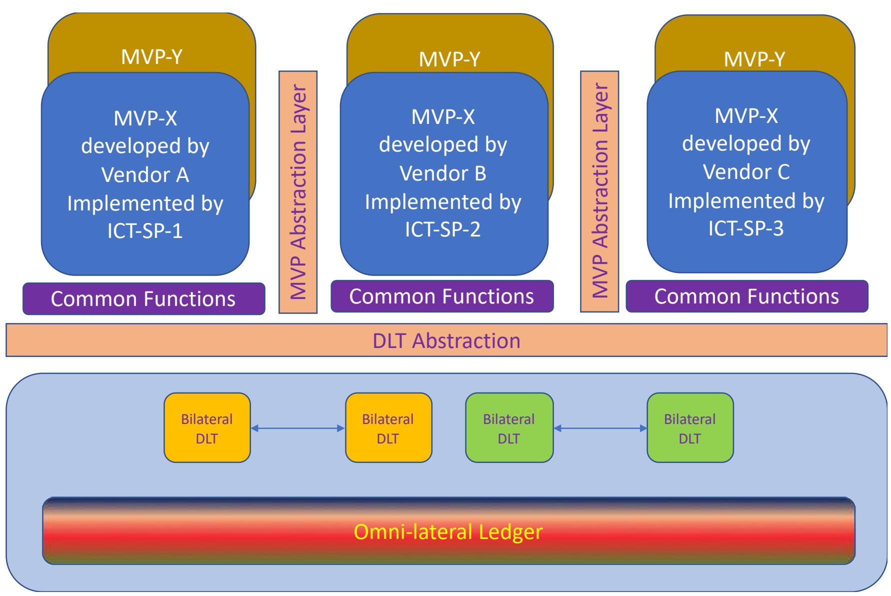


Figure 6-2 - DLT and MVP Abstraction Architecture - Phase 2

7 Data on Demand Commercial and Operational Reference Architecture

The MEF LSO Reference Architecture (MEF 55) [6] represents a federation of ICT-SPs, the internal functional elements and the reference points between them. Specifically, the LSO Reference Architecture (LSO RA) divides the ICT-SP functionality into four functional entities:

- The Business Apps functional element (BUS)
- The Service Orchestration Function functional element (SOF)
- The Network Management functional element (NMS)
- The Element Management functional element (EMS)

MEF has also defines several LSO Interface Reference Points ("IRP"s) through which functional elements/entities exchange information with other functional elements/entities during the lifecycle of a service. Those LSO IRPs are divided into:

- "North-South" IRPs - representing internal flows of information between layers that belong to the same operational entity
- "East-West" IRPs - representing external flows of information between similar functional elements that belong to different operational or commercial entities.

This document focuses on Business and Orchestration, so the Network and Element Management layers are not discussed. The goal is to define a Business and Orchestration framework that is agnostic to the underlying Network and Element layers, which will be represented through product, service and element catalogues and inventory systems.

Where this work differs from the LSO RA is that it:

1. Adds a multi-domain commercial framework.
2. Restructures the Business functional element (LSO BUS) by breaking it to a "Selling" sub-functionality and a "Buying" sub-functionality.
3. Restructures the Orchestration functional element (LSO SOF) by breaking it into an "End-to-End Orchestration" sub-functionality and an "Internal Orchestration" sub-functionality.

This project will only briefly address the "Internal Orchestration" sub-functionality, as this is already covered in MEF-55. It is also noted that existing MEF work covers this sub-functionality by adding additional service types (e.g. Cloud) and by adding a multi-layer orchestration functionality for ICT-SPs with complex and layered architectures that require hierarchical orchestration.

An additional difference from the MEF LSO RA is the elimination of the Cantata, Allegro and Interlude IRPs and their aggregation into a single east-west IRP, namely Sonata. The reasons behind that are the following:

1. Considering a chain of ICT entities (consumers and ICT-SPs), Cantata and Sonata convey the same types of information with the difference being that MEF Cantata represents information exchange between an end-customer and an ICT-SP, and MEF Sonata represents information exchange between two ICT-SPs. Since the process within an ICT-SP will be the same regardless if the eastbound neighbor is an end-customer or another ICT-SP, there is no difference, for the purpose of this document, between the two. A Cantata IRP can be implemented as a Sonata IRP. There are scenarios where certain differences exist (e.g. provisioning) and those are detailed case by case.
2. Interlude and Allegro represent information exchange between the Orchestration layers of entities. It was designed with the mindset of a subset of Sonata that does not contain commercial information. The fact of the matter is that there is hardly any east-west information exchange between entities that does not, potentially, have commercial implication. As a result, the reference architecture used in this document eliminates the Interlude/Allegro interfaces and as described in the below sections - funnels all east-west transactions between the buying and selling sub-functionalities through the Sonata IRP.

The following diagram presents an abstract flow of information through a chain of ICT-SPs as described above.

Note: The I-SOF (N) element in the diagram and the catalogues are depicted for reference and clarity of context but *are out of scope of this document.*

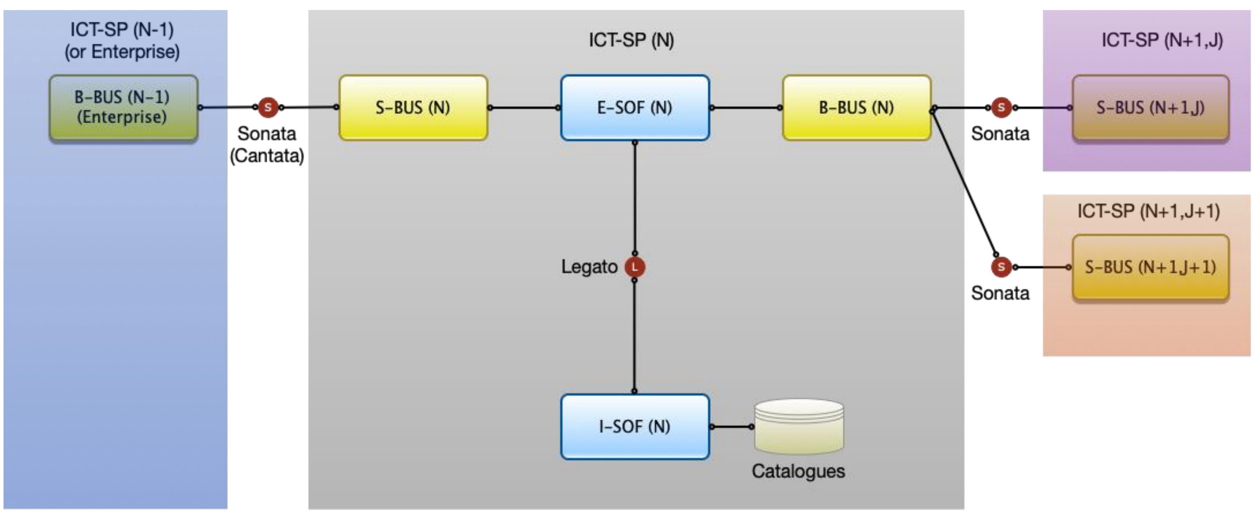


Figure 7-1 - Data on Demand Commercial and Operational Reference Architecture

The B-BUS of ICT-SP (N) may initiate requests with the S-BUSes of more than one ICT-SP. In such case the S-BUSes of those ICT-SPs will be named S-BUS (N+1,i), S-BUS (N+1, i+1) etc.

7.1 The Benefits of using DLT

DLT offers the following benefits:

- Enables commercial netting & settlement processes

- Establishment of dynamic commercial arrangements among CBAN members acting as peers in a supply chain, without the need of an external 3rd party.
- Bilateral transparency between partners while retaining commercial confidence of sensitive information.
- Reputation management (while hiding actual identity across a supply chain)
- Real-time inventory / prevent “double spend/commit” on resources.
- Performance monitoring and reconciliation per the terms of a Service Level Agreement.
- Transparency of Order/Service/Billing status
- Shared catalogues (full or partial sharing)
- Use of smart contracts to calculate mark-up/credit etc.
- Smart contracts can provide a level of real-time automation by transparently handling a number of commercial contingencies.

7.2 Service Lifecycle Process Steps

This section provides detailed flows and actions in and between the functional blocks defined above, respective to various events in the lifecycle of a service, while indicating where DLT may offer value to such actions.

7.2.1 Inquiry and Quote

Service details include: Locations, Bandwidth, QoS, VNF details (CPU, OS, RAM, Storage…)

1. B-BUS(N-1) sends details to S-BUS(N).
2. S-BUS(N) records the request, identifies similar requests from other B-BUSs, and sends the request to E-SOF(N).
3. E-SOF(N) breaks the inquiry into actionable items, inquires with I-SOF(N) capability to deliver each item.
4. For each undeliverable item E-SOF(N) breaks it down to even smaller items until all undeliverable atomic service elements are identified.
5. E-SOF(N) keeps track of all service items deliverable by I-SOF(N) and their associated commercial attributes.
6. E-SOF(N) sends all undeliverable items (as well as, at their discretion, other elements that may have been sourced internally) to B-BUS(N) for external procurement.
7. B-BUS(N) sends inquiries for each undeliverable element to [all/select?] S-BUS(N+1,J).
8. B-BUS(N) receives responses including availability and commercial terms from S-BUS(N+1,J) for inquiries made.
9. B-BUS(N) sorts responses (per inquiry) based on criteria such as Price, SLA, Lead-Time, Proximity of response to requested service.
10. B-BUS(N) makes the selection and forwards to E-SOF(N) the preferred choice [or more than one?] per externally deliverable service element including SLA and commercial parameters.
11. E-SOF(N) checks integrity and feasibility of the (N+1) to (N-1) solution including internally and externally sourced service elements. Integrity may also include “hop-count”, SLA and other criteria.
12. One of the following occurs:

12.1 If feasible and all service elements are deliverable - sends to S-BUS(N) for mark-up and quote. S-BUS(N) applies commercial logic (mark-up, volume discount etc.) and sends quote to B-BUS(N-1).

12.2 If partially feasible (some service elements deviate from request or missing) or non-deliverable - sends to S-BUS(N) for renegotiation with B-BUS(N-1). S-BUS(N) reports to B-BUS(N-1) that service is partially deliverable or undeliverable. Depending on the API version it may be optional to suggest an alternative.

Each quotable element of service must have a unique ID.

Mandatory Requirement 3 - Each quotable element of service MUST have a unique ID.

Quotes may be grouped under a master Quote/Inquiry ID for reference purposes.

Recommendation 1 - Quotes MAY be grouped under a master Quote/Inquiry ID.

A quote must have a validity expressed in time with a timestamp.

Mandatory Requirement 4 - A quote MUST have a validity expressed in time with a timestamp.

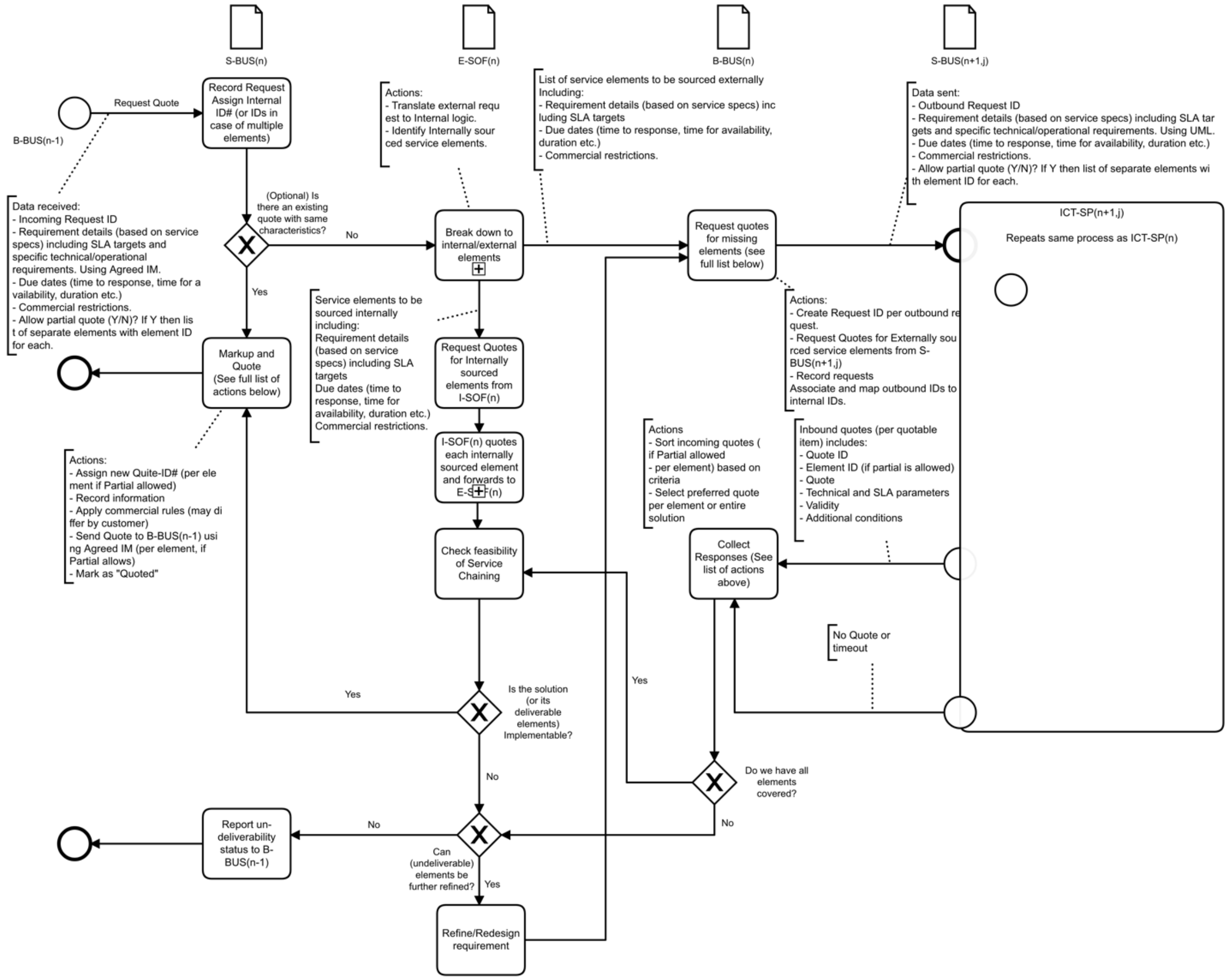


Figure 7-2 - Inquiry and Quote Workflow

7.2.2 Ordering

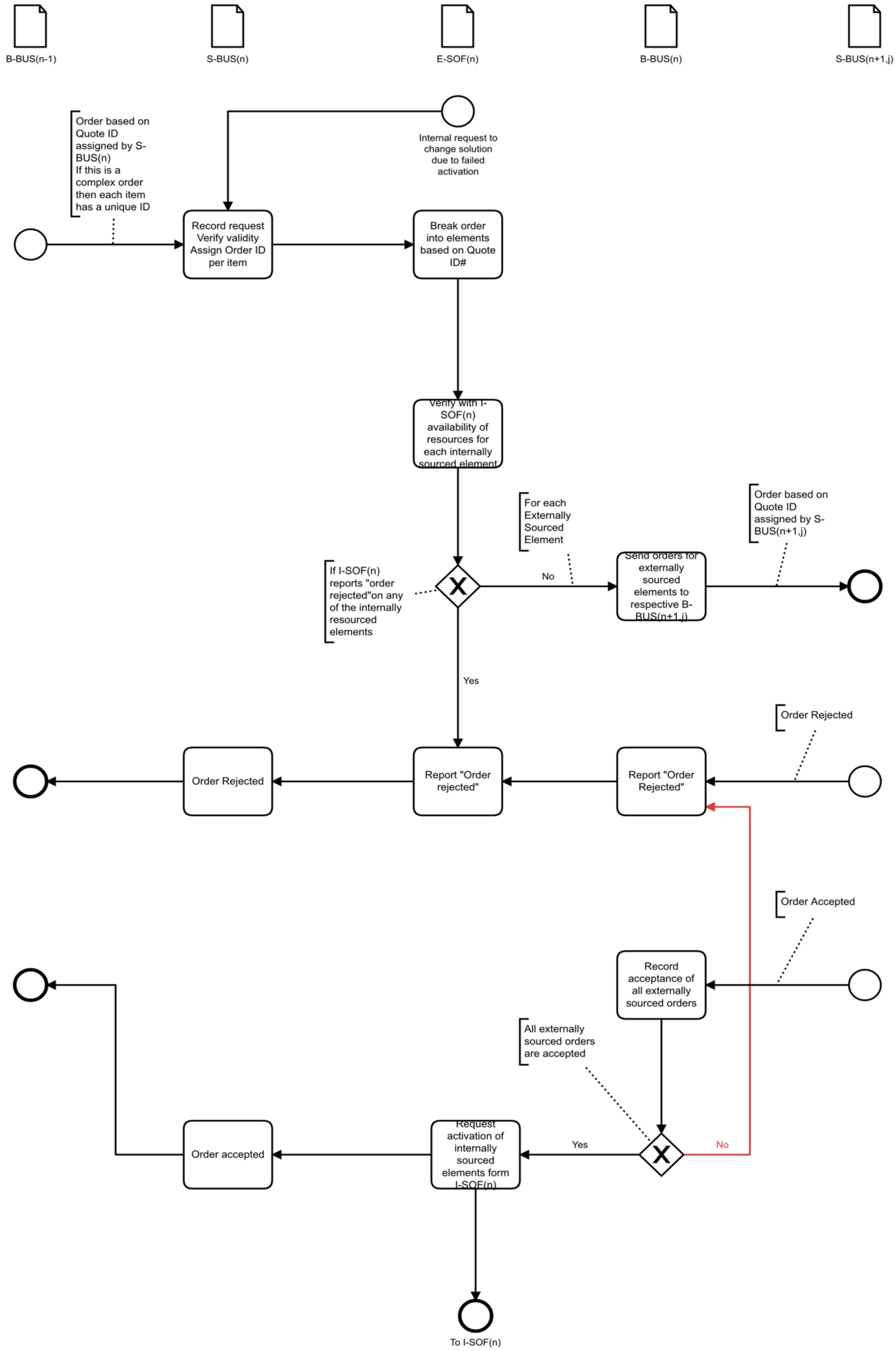
1. B-BUS(N-1) sends order to S-BUS(N) referring to Inquiry ID#.
2. S-BUS(N) records the request, identifies ID#, verifies validity, and sends the request to E-SOF(N).
3. E-SOF(N) breaks order to smaller items based on information recorded in Inquiry ID#, Verifies availability of resources for each and all internally sourced elements with I-SOF(N), while avoiding double-spend of resources.
4. If I-SOF(N) reports “order rejected” on any of the internally sourced elements - E-SOF(N) reports to S-BUS(N) “order rejected”. Otherwise:
5. For each externally sourced item E-SOF(N) forwards the details with element ID# to B-BUS(N).
6. B-BUS(N) sends orders for each externally sourced element to the respective S-BUS(N+1,J) based on the service element ID# in the Inquiry ID# and Quote ID#.
7. B-BUS(N) receives responses from the respective S-BUS(N+1,J) for each order. The response can be “Order accepted” or “Order rejected” and reports acceptance/rejection to E-SOF(N). Depending on API version, the reason for rejection can be detailed.

8. If all responses from B-BUS(N) for each and all elements of service are “accepted” then E-SOF(N) reports “order accepted” to S-BUS(N) and requests activation of internally sourced elements from I-SOF(N).
9. S-BUS(N) reports “order accepted” to B-BUS(N-1).
10. If any response for an order of any element of service, internally or externally sourced, is “order rejected” then E-SOF (N) reports to S-BUS(N) “order rejected” and S-BUS(N) reports same to B-BUS(N-1).

An order must include a timeout period. If the supplier is unable to confirm the order within said timeout period – it automatically expires. Each downstream ICT-SP along the supply chain should derive its own internal timeout periods based on its customer’s timeout.

Mandatory Requirement 5 - An Order MUST include a timeout period.

Recommendation 2 - Each downstream ICT-SP along the supply chain SHOULD derive its own in-ternal timeout periods based on its customer’s timeout.



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436 *Figure 7-3 - Ordering Workflow*

7.2.3 Provisioning

Provisioning is handled by each ICT-SP based on orders. The document does not detail how each ICT-SP delivers each element of service. This document does define however the way in which a service that was delivered is handed off to the upstream ICT-SP.

Based on the ordering process defined above - internally sourced elements of the service will only be activated if and when all externally sourced elements of the service have initiated the activation process. However, activation may not be instantaneous and there is a possibility that in a chain of nested activation processes, certain elements may be activated prior to others, not necessarily in the sequence of the service topology.

  - E-SOF(N) instructs I-SOF(N) to activate each and all internally sourced elements of service. For each internally sourced element: I-SOF(N) activates internally sourced elements.
  - I-SOF(N) reports “service element activated”
  - E-SOF(N) chains internally sourced elements in topology/sequence.

1. Once all internally sourced elements have been activated and chained - For each externally sourced element (grouped by ICT-SP):

    - S-BUS(N+1,J) reports to B-BUS(N) “service element activated”
    - B-BUS(N) reports to E-SOF(N) of same
    - E-SOF(N) chains the externally sourced element into topology/sequence.
    - E-SOF(N) performs “ICT-SP(N) to end” test.

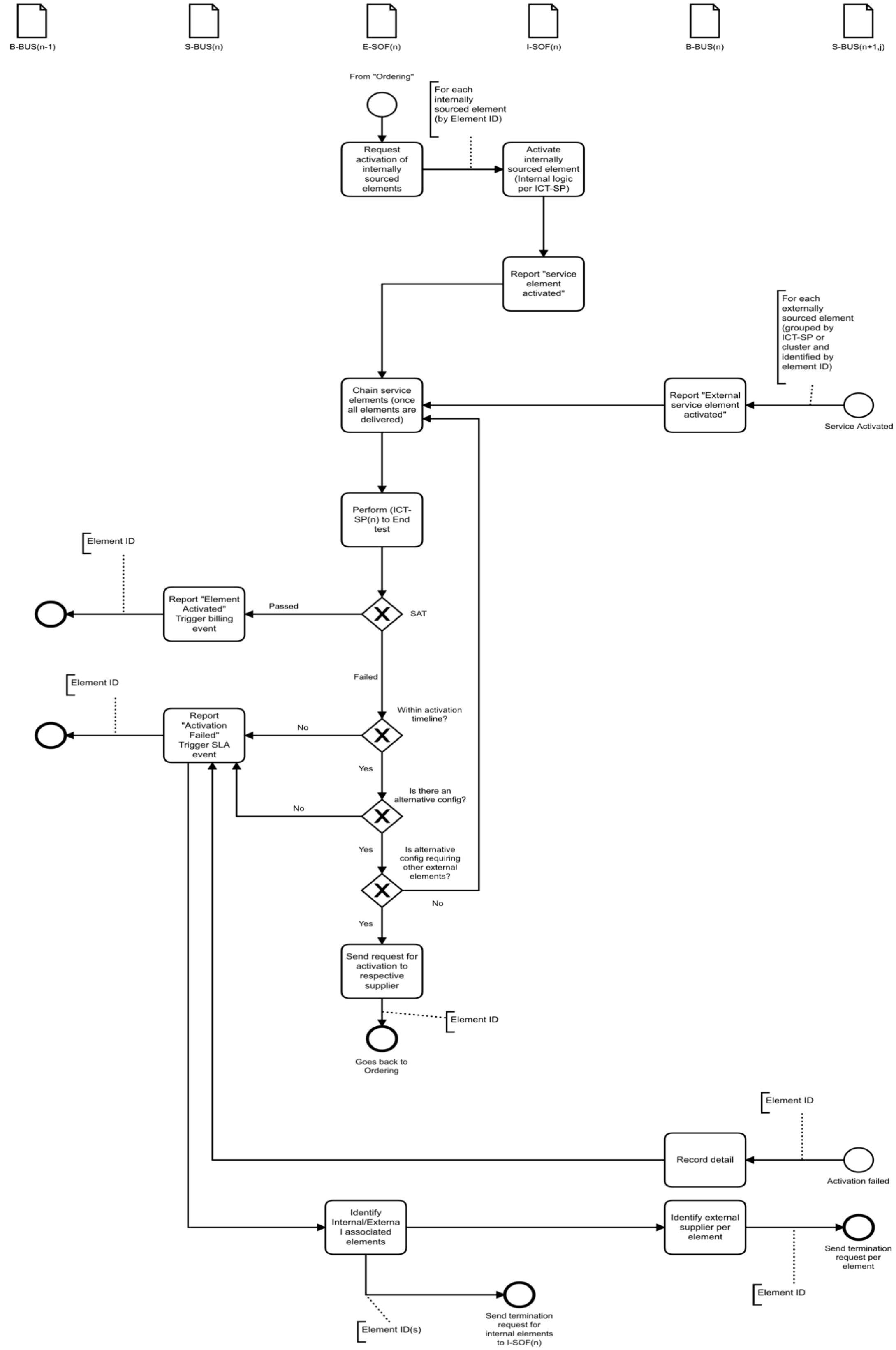
2. Once all ICT-SP(N) to end” tests have been successfully completed - E-SOF(N) reports to S-BUS(N) “service delivered”:

    - S-BUS(N) reports to B-BUS(N-1) “service delivered”.

Future versions of this document will consider failure to activate certain elements and the resulting actions:

- Delay in delivery (may be subject to penalty).
- Inability to deliver (permanently or within a specified time) that will lead to cancellation of order and failover to alternative (internally or externally sourced)

There may be SLA (performance) and commercial implications to failover to alternative supply path.



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468 *Figure 7-4 - Provisioning Workflow*

7.2.4 SOAM (Service Operations and Maintenance)

7.2.4.1 Fault identification and repair

SOAM (Service Operations and Maintenance) of an on-demand service that typically lasts minutes to hours may be significantly different from the SOAM of long term services that lasts months and years. While fault repair of a long term service will typically be through repair or replacement of faulty elements of the service (e.g. replacement of a broken card, repair/splicing of an optical cable, replacement of a failed disc) failure of an on-demand service will typically be handled through termination and re-establishment of the service on fresh resources that bypass the failed elements. The user may not even report the failure unless it is repetitive and the attempts to re-establish the service (i.e. hang up and redial) don't lead to a stable service.

There are two scenarios to take into consideration:

7.2.4.1.1 Proactive repair without customer ticket

I-SOF(N) should be able to proactively identify faults and suspend faulty elements from being re-used (remove from inventory, close loop automation depending on root cause). Repair/replacement should be done once item is not in use.

Recommendation 3 - I-SOF (N) SHOULD be able to proactively identify faults and suspend faulty elements from being re-used.

Once item is repaired, it is returned to inventory for future use.

As part of this scenario the customer may be eligible to credit due to performance being below SLA targets. Eligibility may be subject to customer making a formal request as per agreement between parties.

7.2.4.1.2 Reactive repair based on customer ticket

If a ticket is opened by ICT-SP(N-1) through a message sent from B-BUS(N-1) to S-BUS(N).

1. S-BUS(N) records the event (for SLA purposes) and reports the fault to E-SOF(N)
2. E-SOF(N) identifies the source of the fault (element in chain at fault).
3. If the element is internally sourced, it reports to I-SOF(N)
4. I-SOF(N) fails-over to a healthy element (preferred because faster) or repairs the faulty element.
5. Once failover/repair is complete I-SOF(N) reports to E-SOF(N) "service restored".
6. If the element is externally sourced then E-SOF(N) requests B-BUS(N) to open a ticket with ICT-SP(N+1,J), where "J" represents the respective ICT-SP from which the (Now faulty) service element was sourced.
7. B-BUS(N) opens a ticket with S-BUS(N+1,J)
8. Once B-BUS(N) receives confirmation from S-BUS(N+1,J) that "service is restored" it records the event (for SLA purposes) and reports the same to E-SOF(N)

9. Once E-SOF(N) received confirmation from all internal and external sources that “service is restored” it performs an “ICT-SP(N) to end” test and if successful - reports to S-BUS(N) “service restored”.
10. S-BUS(N) records event (for SLA purposes) and reports to B-BUS(N-1) “service restored”.

In this scenario the customer is eligible to SLA credits based on performance records and timelines.

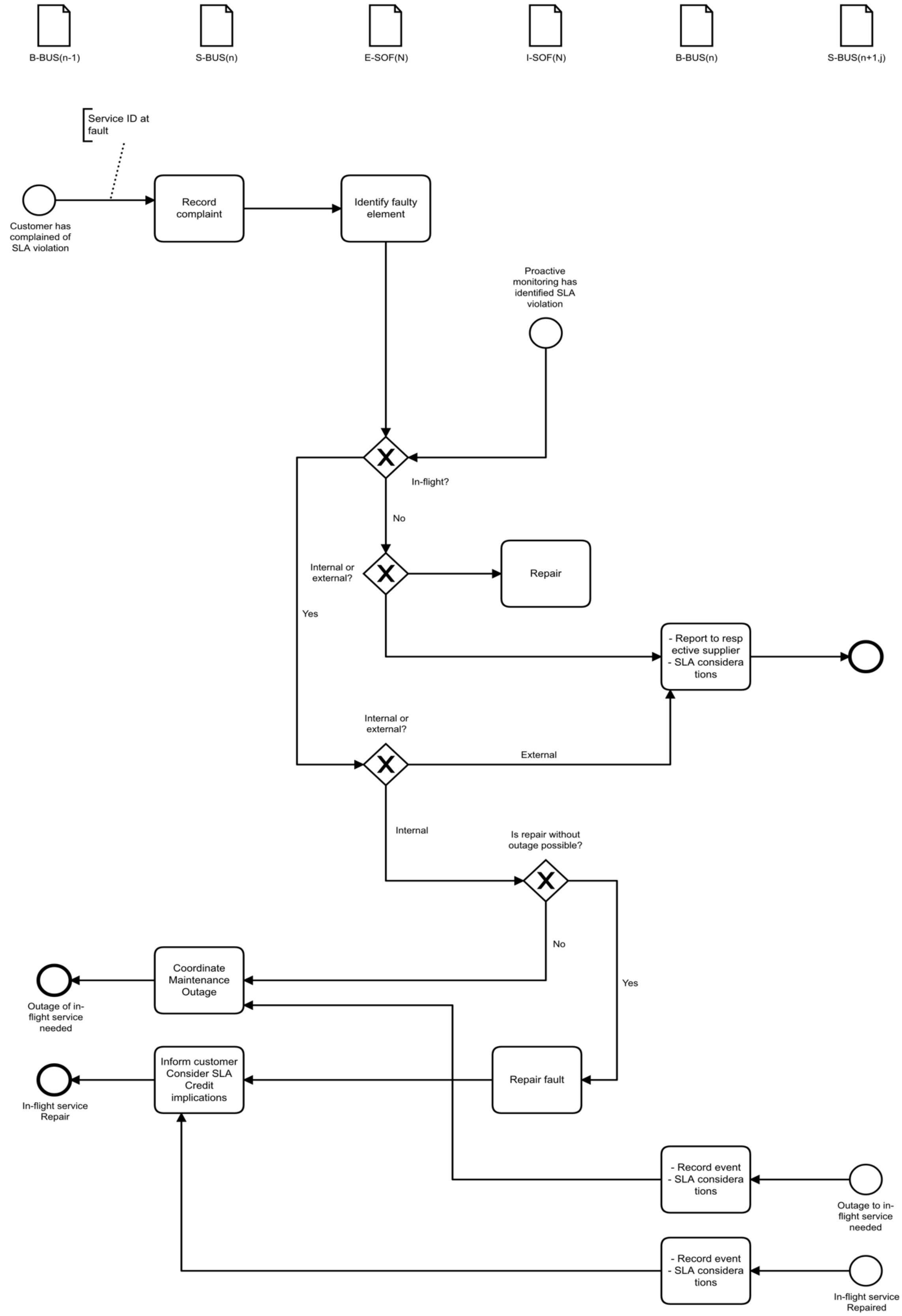


Figure 7-5 - SOAM (Service Operations and Maintenance) Repair Workflow

7.2.4.2 Performance Monitoring and Utilization Measurement

ICT-SP(N) is responsible for monitoring performance and utilization of each internally and externally sourced element of service. The parameters to be monitored vary by service type and are subject to agreements between ICT-SP(N) and its neighboring ICT-SPs. MEF-52 [7] defines the framework by which performance monitoring and reporting is performed for services delivered on a multi-domain environment.

In a nutshell the process can be defined as follows:

There are two options to generate reports:

1. Scheduled reports that are generated on agreed upon intervals.
2. On-request reports that are generated on request of any ICT-SP (or customer) and apply to that ICT-SP/Customer and all onwards ICT-SPs in the chain of supply.

Propagation of a request for an on-demand report:

1. S-BUS(N) receives a request for a report for a specific service from B-BUS(N-1), records the request and forwards to E-SOF(N).
2. E-SOF(N) requests report for each and all internally sourced elements for said service from I-SOF(N) and for each and all externally sourced elements for said service from B-BUS(N).
3. B-BUS(N) sends requests to S-BUS(N+1,J)'s each for their respective externally sourced elements for said service.

Collection and aggregation of report data (valid for both scheduled and on-demand reports):

1. B-BUS(N) receives performance reports from S-BUS(N+1,J), records the data and forwards to E-SOF(N).
2. I-SOF(N) records performance data of internally sourced elements of service and reports the same to E-SOF(N).
3. E-SOF(N) adds the performance data of all internally and externally sourced elements of the service based on chaining sequence and topology and then generates an "ICT-SP(N) to end" performance report, which is sent to S-BUS(N).
4. S-BUS(N) records the data (for SLA purposes) and forwards the report to B-BUS(N-1).

Specific considerations for on-demand services:

- Performance, faults and duration should be recorded on a per-service-instance.

Recommendation 4 - Performance, faults and duration SHOULD be recorded on a per-service-instance.

- Billing intervals may cover multiple service instances and each must be identifiable for SLA credit negotiation and settlement purposes.

Recommendation 5 - Billing intervals MAY cover multiple service instances.

Mandatory Requirement 6 - Each billing interval MUST be identifiable for SLA credit negotiation and settlement purposes.

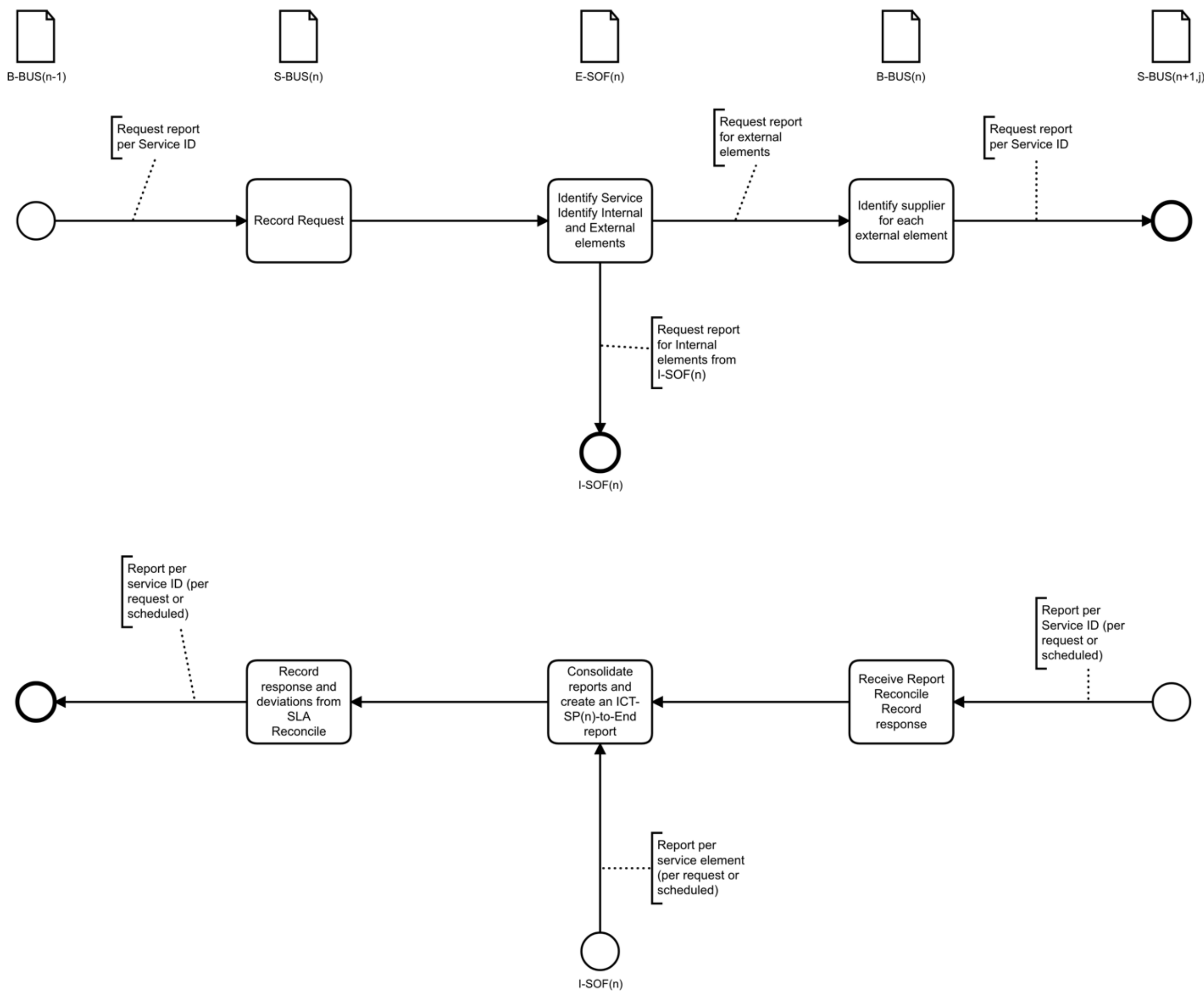


Figure 7-6 - SOAM (Service Operations and Maintenance) Fault Reporting Workflow

7.2.4.3 Defining the SLA Reputation

SLA Reputation is a score representing a running average of the deviation between actual performance and committed performance. The committed performance levels are defined in the SLA. The actual performance is derived from measurement of service parameters as defined in section 8.2.4.2 (Performance Monitoring and Utilization Measurement) and from outage or fault repair information as defined in section 8.2.4.1 (Fault identification and repair). The running average gives a higher weight to recent data and a reduced weight to ageing data. The timeline for decay of weight is dependent on service characteristics and is calculated based on the average duration of service instances.

7.2.5 Billing, Reconciliation and Settlement

The billing phase is divided into three categories:

- Billing - where the Payee invoices the Payer for the amount stipulated by the agreement and based on utilization information and SLA or other credits as applicable based on agreement.

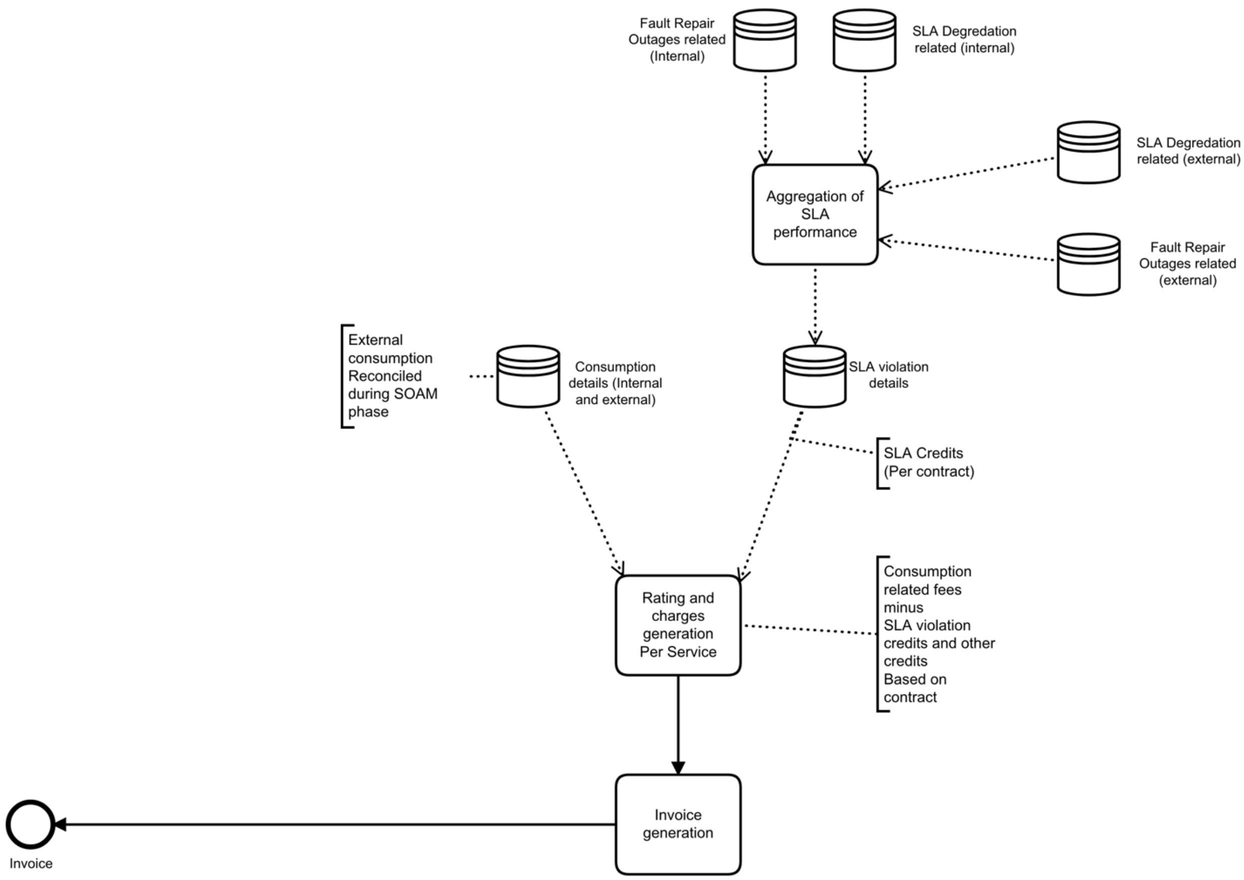


Figure 7-7 Invoicing Information Flow

- Reconciliation - the process of reaching agreement in case of a dispute.

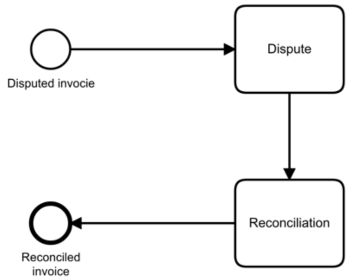


Figure 7-8 - Reconciliation Information Flow

- Settlement - the transfer of monetary funds between parties based on billing and reconciliation.

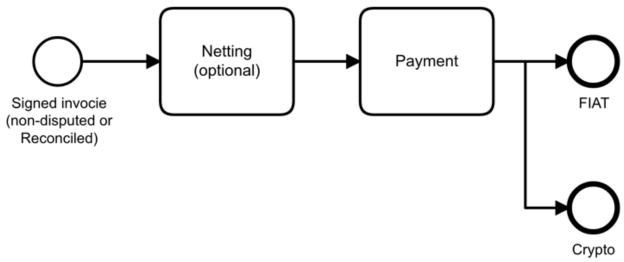


Figure 7-9 - Settlement Information Flow

The billing is calculated through subtracting credits from amounts due coming up with net amount to be invoiced.

7.2.5.1 Billing

Each ICT-SP(N) bills its customers (ICT-SP(N-1) or an enterprise/retail customer) for the services the customer has consumed and is being billed by its supplier's ICT-SP(N+1,J) for the elements of services consumed from them. The billing can be on a "per-service" instance, aggregated over a period of time, aggregated up to a threshold, based on a fixed-fee periodical use or any other commercial agreement between neighboring ICT entities, including enterprise or individual consumers. This document follows the billing options discussed in detail in MEF-74 [3]. [3]Billing is expressed in currency, FIAT or settlement token as agreed by both parties.

The billing may include credits for failure to meet an agreed upon SLA. Such credits can be calculated on a per-service-instance basis or aggregated in agreed-upon forms. MEF-74 [3] defines methods of measurement of data services and methods of measuring performance and applying credits based on deviation of performance from SLA targets.

It is recommended that invoices are submitted in a machine-readable format so they may be processed by the recipients' financial platforms with no need for manual data entry.

Recommendation 6 - Invoices SHOULD be submitted in a machine-readable format.

The below table is an excerpt from section 7.3 in MEF-74 [3] titled ‘Payments and settlements’ with an additional column describing the role DLT can play in this part of the settlements process.

Payment Attribute Term	**Definition**	**DLT Role**
Credit Score	The amount of confidence a seller has with the buyer to pay their bills. Example: the customer has missed the due date an average of one out of 4 of its last payments, thus it has been given a credit score of 75%.	See entry in next row
Payment History/Payment Record/Payment cycle time	The duration from forwarding an invoice from seller to buyer until payment of same is received by the seller. Example: Payment was received an average of 45 days after invoice date.	Credit reputation can be associated with an ICT-SP pseudononimously through Omniledger. DLT may be used to support the need for entities to state different payment terms (1x1, 3x1, 7x7, 15x15, 30x15, 30x30, 45x45 etc.), facilitated by way of a smart contract between two entities. Payment cycle time can be automatically calculated on a regular basis.
Credit Allocation	The amount of monetary funds that a buyer can consume prior to making payment to seller. This is typically derived from credit score and payment history. Example: the customer has been allocated a USD 5000 credit.	Credit reputation can be associated with an ICT-SP pseudononimously through Omniledger.
Deposit	An amount pre-paid by the buyer to the seller prior to consuming services. This is typically derived by multiplying the [Recurring Selling Price (in the event of a fixed recur-ring amount) or the estimated recurring amount to be billed (in the case of usage-based recurring amount)] by the Payment History.	DLT may be used to allocate FIAT stable coin and stable coin or Crypto assets with the ability to perform atomic swaps to facilitate exchange between a diverse set of currencies. Token balances bay be used for deposit or as a replacement to deposits.

Payment Attribute Term	Definition	DLT Role
Payer	An entity that pays or is requested to make a payment to another entity. This will typically be the same entity as the buyer, though "Buy/Sell" typically refers to services and products while "Pay/Receive" typically refers to monetary exchange.	It is recommended that Know-Your-Customer and Anti-money laundering laws be part of the entry process when entities conduct business with each other in the CBAN. Adopting a financially regulated environment where compliance checks can be independently carried out should be a pre-requisite to payment finality for anyone operating within the CBAN. KYC documents should be stored in a decentralized Self-Sovereign Identity so they can be re-shared with other entities.
Payee/Receiver	An entity that request and/or receives a payment from an-other entity.	Same as for Payer.
Settlement	The process of analyzing the amount a Payer is invoiced by the Payee, comparing the resource usage and the monetary amounts associated with use of the resource as per commercial agreement, identifying the differences between the Payee's records and calculations to those of the payer. The differences may be settled either automatically or manually through algorithms.	Settlement cycles can be triggered by the smart contract. Elimination of dispute about source data (does not eliminate dispute about commercial aspects). Elimination of commercial dispute through smart-contracts. Automated reconciliation.

Payment Attribute Term	Definition	DLT Role
Payment	Transfer of monetary funds from payer to payee. A Payment may cover multiple services or products.	Use of FIAT-to-settlement token and settlement token-to-FIAT atomic swaps to facilitate money in/out to a diverse set of currencies. Automated payment finality using settlement tokens (requires all members of the CBAN can send/receive payments within the network environment). An immutable audit trail on any settlement logs and transactions. All negotiated, contracted expectancies, such as payment terms, SLA, agreed costs based on units of measure data, as well as any cost associated with any SLA deviation could be supported through automation via DLT.

597 *Table 3 - Financial and Commercial Terms*

598 Abstract Invoicing WF:

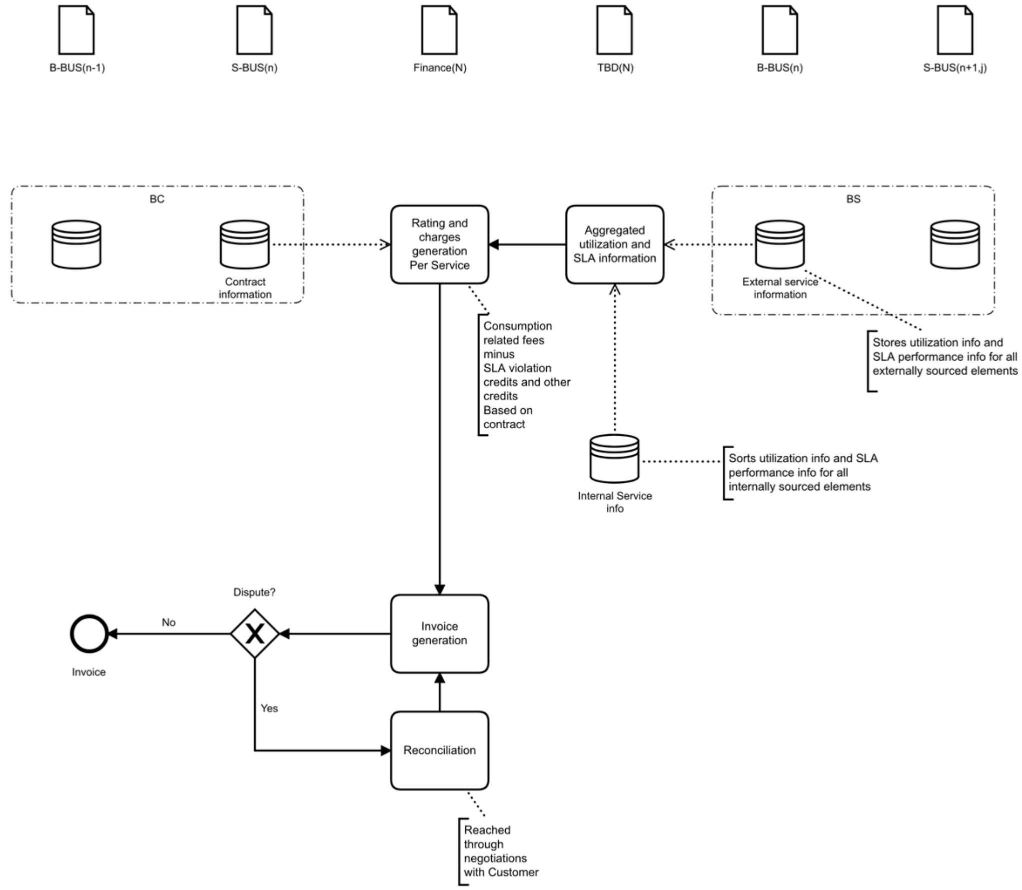


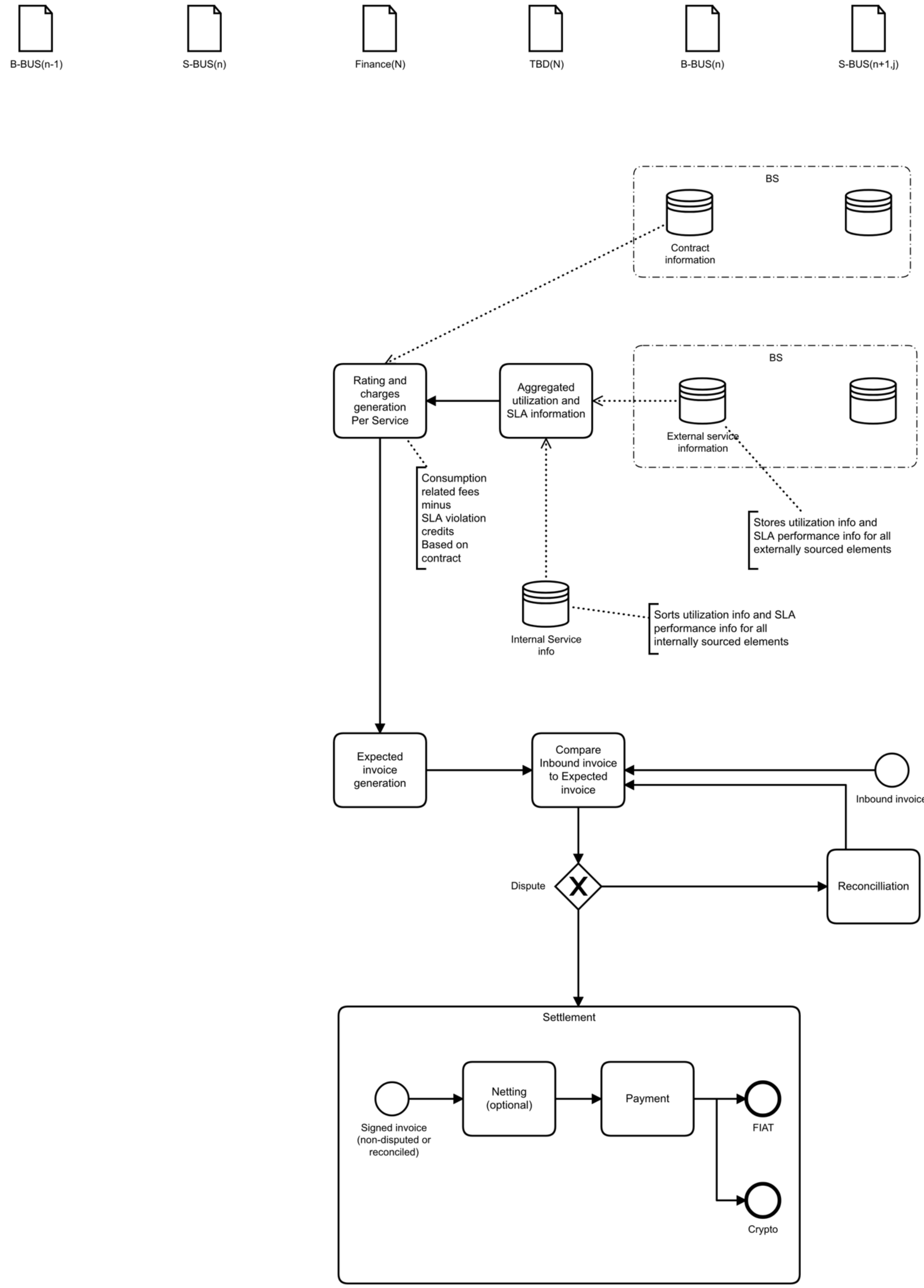
Figure 7-10 - Invoicing Flow

7.2.5.2 Reconciliation

Upon receipt of an invoice from ICT-SP(N-1), ICT-SP(N) compares the details and amounts with its own records (agreement, utilization records, SLA performance) and identifies discrepancies, if any exist.

In case discrepancies exist and exceed a threshold self-defined by ICT-SP(N), ICT-SP(N) will initiate a reconciliation process with ICT-SP(N-1). The reconciliation process may vary depending on agreement between each pair of bilateral partners or based on internal policies of each ICT-SP. The process may be based on comparison of records and contract terms between the partners and identifying the source of the discrepancy. It can be based on agreement to split the difference (evenly, or unevenly based on a moving average learned through heuristics) or any other method agreed by the bilateral partners. It may include both of those methods and others too. It is beyond the scope of this document to offer a detailed implementation agreements which, in extreme cases, may end up in court. However, the process will result in a mutually agreed upon amount ICT-SP(N) has to pay to ICT-SP(N-1).

Recommendation 7 - The reconciliation process SHOULD result in a mutually agreed upon amount to settle.



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618 *Figure 7-11 - Reconciliation and Settlement Flow*

7.2.5.3 Settlement

Once Reconciliation is complete ICT-SP(N) will pay ICT-SP(N-1) the agreed upon amount.

Payment will be made in accordance to the terms stipulated in the agreement, some examples of which are listed herewith:

- Immediately upon end of reconciliation (Referred to as "Net").
- A pre-defined period of time after reconciliation (e.g. payment 30 days after reconciliation. Referred to as "Net+30").
- Accumulate reconciled invoices during a certain period and pay the sum of all invoices at agreed upon intervals (e.g. "Monthly on the first day of the following month").
- In the event that ICT-SP(N) and ICT-SP(N-1) have reciprocal business - the settlement may net the mounts due on both sides and ICT-SP(N) will only pay (or be paid) the balance due.
- In the event that an amount has been pre-paid in advance - the payment will include the balance between reconciled amount and pre-paid amount.

7.2.5.4 Defining payment and financial stability reputation

The payment and financial stability reputation is a score calculated based on payment history and credit score of an entity (either an ICT-SP, an enterprise customer or a consumer). The score is derived from timeliness of payments, accuracy of payments, duration and effectivity of reconciliation process compared to a target performance defined in agreements signed between the entity and its suppliers. The score may also take into account information received from external sources such as analyst reports and publicly available financial records.

7.2.6 Change Management

Change management refers to changes made to in-operation service instances.

Changes may include:

- Termination of service.
- Change of service characteristics.
  - Change of QoS.
  - Change of a service parameter (Bandwidth, CPU, number of seats etc.)
  - Relocation of an endpoint.
  - more

With the exception of termination, changes to in-operation service instances can be split to two:

- Changes that can be made without interrupting service:
  - Change of bandwidths
  - change of QoS
  - Add/Remove an end point in a multi-end-point service.
  - more

- Changes that interrupt the service:
  - Relocation of an end point.
  - Change of CPU/RAM/OS/Config
  - more

The ordering process of a change to an in-operation service follows the same process as a new quote and a new order with the exception that the inquiry and order must state that they refer to an in-operation service (and include the service ID#) and the responses must state if the change can be performed with or without interruption to service.

The implementation of a change may require a parallel build and a “cold” (downtime for re-cabling) or “hot” (software re-route) swap. In other cases, the implementation may not require a swap but may require software reconfiguration. If such implementation is expected to cause service interruption, it must be coordinated between the parties and agreed by the ultimate customer (ICT entity originating the request) and all ICT-SPs that are required to take action as a result of such change request (Note that in complex services changes to certain part of the service may not affect other parts, e.g. upgrade of bandwidth between two end points in a multi-point VPN may not affect the other end points in that VPN and may not require any action from the ICT-SPs delivering the elements of service related to those other locations).

8 Data Management and Repositories

8.1 Data Repositories:

Data repositories must support the following levels of visibility:

8.1.1 Private:

Private repositories contain information that will be used internally be the ICT-SP and does not need to be shared with any other external entity. These repositories are marked as “**PR**” in the workflow diagrams and tables.

8.1.2 Bilateral:

Bilateral repositories contain information that is shared with another ICT-SP and are broken down to two types:

8.1.2.1 Bilateral with Customer (BC):

These are repositories that contain information which is shared with the Buyer ICT-SP and are marked as “**BC**” in the workflow diagrams and tables.

8.1.2.2 Bilateral with Supplier (BS):

These are repositories that contain information which is shared with the Supplier ICT-SP and are marked as “**BS**” in the workflow diagrams and tables.

8.1.3 Omni:

Omni repositories contain information that is shared with a larger group of ICT-SPs, potentially all ICT-SP participants of CBAN and are marked as “**Omni**” in the workflow diagrams and tables.

The same Information may be stored in more than one of the above repositories, serving different purposes.

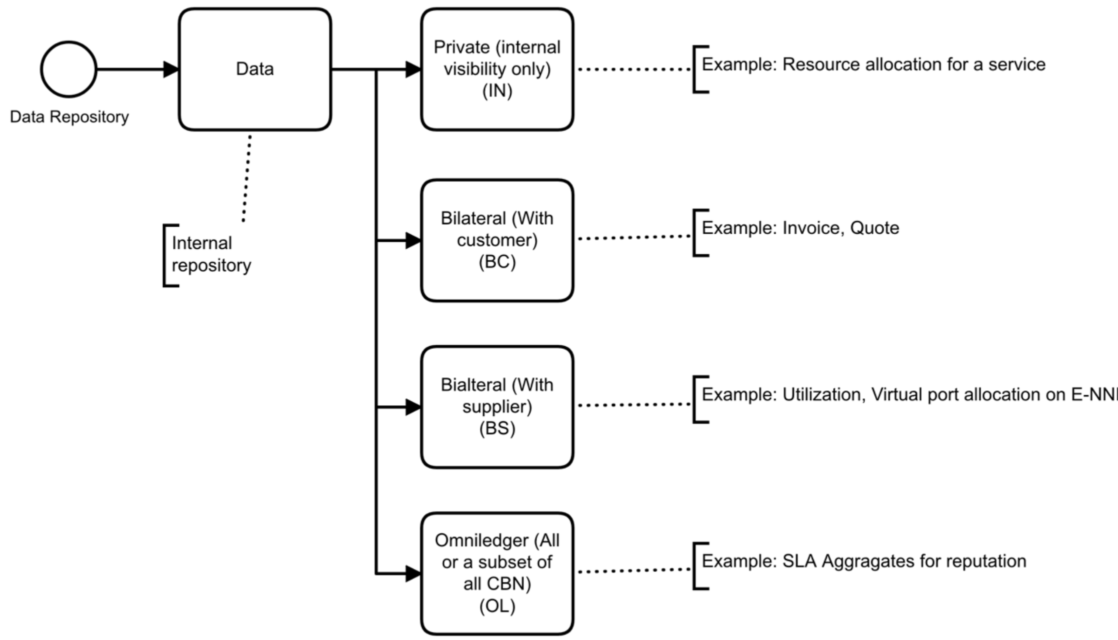

Figure 8-1 - Data Repositories

The below table details the information flow in the workflow diagrams described in chapter 8 above.

Actor	**Action**	**Comment if applicable**	**Action broken down (if needed)**	**Data source where applicable**	**Ledger used**
B-BUS(N-1)	Request quote		Data received: - Incoming request ID - Requirement details (based on service specs) including SLA targets and specific technical/operational requirements. Using Agreed IM. - Due dates (time to response, time for availability, duration etc.) - Commercial restrictions. - Allow partial quote (Y/N)? If Y, then list of separate elements with element ID for each.	B-BUS(N-1)	IN
S-BUS(N)	Record Request		Assign Internal ID# (or IDs in case of multiple elements)	PR	BC
S-BUS(N)	(Optional) Is there an existing quote with same characteristics?	Existing quote yes	Markup and Quote: Actions: - Assign new Quite-ID# (per element if partial quote is allowed) - Record information - Apply commercial rules (may differ by customer) - Send Quote to B-BUS(N-1) using Agreed IM (per element, if partial quote is allowed) - Mark as "Quoted"	PR	BC

E-SOF(N)	(Optional) Is there an existing quote with same characteristics?	Existing quote no	Actions: - Translate external request to internal logic. - Identify internally sourced service elements and breakdown to internal/external elements.	Internal catalogue/ external catalogue	OL
E-SOF(N)	Request quotes for internally sourced elements from I-SOF	Internal element/s	Service elements to be sourced internally including: - Requirement details (based on service specs) including SLA targets - Due dates (time to response, time for availability, duration, etc.) - Commercial restrictions	Internal catalogue	PR
I-SOF(N)	I-SOF quotes each internally sourced element and forwards to E-SOF	Internal element/s		Internal catalogue	BC
E-SOF(N)	Check feasibility of service chaining	Internal element/s	Is solution (or its deliverable element implementable? YES		BC
E-SOF(N)	Request quotes for externally sourced elements from B-BUS	External element/s	List of service elements to be sourced externally, including: - Requirement details (based on service specs) including SLA targets - Due dates (time to response, time for availability, duration etc.) - Commercial restrictions	External catalogues	BS

B-BUS(N)	Request quotes for missing elements	External element/s	Actions: - Create Request ID per outbound request. - Request Quotes for Externally sourced service elements from S-BUS(N+1,J) - Record requests - Associate and map outbound IDs to internal IDs.	External catalogues	BS
S-BUS(N+1,J)	Data sent - outbound request ID	External element/s	Data sent: - Outbound Request ID - Requirement details (based on service specs) including SLA targets and specific technical/operational requirements. Using UML. - Due dates (time to response, time for availability, duration etc.) - Commercial restrictions. - Allow partial quote (Y/N)? If Y, then list of separate elements with element ID for each.		BS

B-BUS(N)	Collect responses	External element/s	Inbound quotes (per quotable item) includes: - Quote ID - Element ID (if partial is allowed) - Quote - Technical and SLA parameters - Validity - Additional conditions - Sort incoming quotes (if partial quote is allowed - per element) based on criteria - Select preferred quote per element or entire solution		BS
S-BUS(N+1,J)	No quote/timeout	External element/s			OL
B-BUS(N)	Do we have all elements covered?	External element/s YES	Send to ESOF n		BC
E-SOF(N)	Check feasibility of Service Chaining	External element/s YES	Is solution (or its deliverable element implementable?) YES: Advise S-BUS n		BC
S-BUS(N)	Is solution (or its deliverable element implementable?) YES - Mark up and quote	External element/s YES	Action: - Assign new Quote-ID# (per element if Partial allowed) - Record information - Apply commercial rules (may differ by customer) - Send quote to B-BUS(N-1) using agreed IM (per element, if partial quote is allowed) - Mark as 'Quoted'		BC

E-SOF(N)	Check feasibility of Service Chaining	External element/s YES	Is solution (or its deliverable element implementable?) NO: Can elements be further refined? YES: Refine/redesign requirement: Request quotes for missing elements: Actions: - Create Request ID per outbound request. - Request quotes for externally sourced service elements from S-BUS(N+1,J) - Record requests - Associate and map outbound IDs to internal IDs.		BC
E-SOF(N)	Check feasibility of Service Chaining	External element/s YES	Is solution (or its deliverable element implementable?) NO: Can (undeliverable) elements be further refined? NO: Advise S-BUS n		IN
S-BUS(N)	Report un-deliverability status to B-BUS n-1	External element/s			IN

B-BUS(N)	Do we have all elements covered?	External element/s NO	Can (undeliverable) elements be further refined? YES: Refine/redesign requirement: Request quotes for missing elements: Actions: - Create Request ID per outbound request. - Request Quotes for Externally sourced service elements from S-BUS(N+1,J) - Record requests - Associate and map outbound IDs to internal IDs		BC
B-BUS(N)	Do we have all elements covered?	External element/s NO	Can (undeliverable) elements be further refined? NO: Advise S-BUS n		IN
S-BUS(N)	Report un-deliverability status to B-BUS n-1	External element/s NO			BC
B-BUS(N-1)	Order based on Quote ID assigned by S-BUS(N) If this is a complex order then each item has a unique ID			BC	BC
S-BUS(N)	Record request Verify validity Assign Order ID per item			PR	BC
E-SOF(N)	Internal request to change solution due to failed activation				IN
E-SOF(N)	Break order into elements based on Quote ID#			PR	IN

E-SOF(N)	Verify with I-SOF(N) availability of resources for each internally sourced element			PR	IN
I-SOF(N)	If I-SOF(N) reports "order rejected“ "on any of the internally resourced elements	Reports 'YES'	If I-SOF(N) reports "order rejected“ "on any of the internally resourced elements	PR	IN
E-SOF(N)	If I-SOF(N) reports "order rejected“ "on any of the internally resourced elements	Reports 'YES'	Report "Order rejected"		BC
S-BUS n	Order Rejected - sent to B-BUS n - 1				BC
I-SOF(N)	If I-SOF(N) reports "order rejected“ "on any of the internally resourced elements	Reports 'NO'			IN
E-SOF(N)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	For each Externally Sourced Element	PR	BS
B-BUS(N)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	Send orders for externally sourced elements to respective B-BUS(N+1,J) Order based on Quote ID assigned by S-BUS(N+1,J)		BS
S-BUS(N+1,J)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	Order rejected		BS

B-BUS(N)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	Report "Order rejected"		IN
E-SOF(N)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	Report "Order rejected"		IN
S-BUS(N+1,J)	If I-SOF(N) reports "order rejected "on any of the internally resourced elements	Reports 'NO'	Order Accepted		BS
B-BUS(N)	Record acceptance of all externally sourced orders	All externally sourced orders are accepted 'YES'			IN
E-SOF(N)	Record acceptance of all externally sourced orders	All externally sourced orders are accepted 'YES'	Request activation of internally sourced elements form I-SOF(N)		IN
E-SOF(N)	Record acceptance of all externally sourced orders	All externally sourced orders are accepted 'YES'	Order Accepted	PR	BS
B-BUS(N)	Record acceptance of all externally sourced orders	All externally sourced orders are accepted 'NO'	Report "Order rejected"		BS
E-SOF(N)	If I-SOF(N) reports "order rejected" on any of the internally resourced elements	All externally sourced orders are accepted 'NO'	Report "Order rejected"		BS
E-SOF(N)	Request activation of internally sourced elements		For each internally sourced element (by Element ID)		IN

I-SOF(N)	Activate internally sourced element (Internal logic per ICT-SP)		Report "service element activated"		IN
E-SOF(N)	Chain service elements (once all elements are delivered)				IN
E-SOF(N)	Perform (ICT-SP(N) to End test	Passed	Report "Element Activated" Trigger billing event (include element ID)		BS
E-SOF(N)	Perform (ICT-SP(N) to End test	Failed			IN
E-SOF(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'NO'	Report to S-BUS(N)		IN
S-BUS(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'NO'	Report "Activation Failed" Trigger SLA event (element ID) to B-BUS(N-1)		BC
E-SOF(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'YES'	Is there an alternative config? 'NO'		IN
S-BUS(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'YES'	Is there an alternative config? 'NO' - Report "Activation Failed" Trigger SLA event (element ID) to B-BUS(N-1)		BC
E-SOF(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'YES'	Is there an alternative config? 'YES' Is alternative config requiring other external elements? YES - Send request for activation to respective supplier (including element ID). EXITS TO ORDERING		BS

E-SOF(N)	Perform (ICT-SP(N) to End test	Failed - within activation time 'YES'	Is there an alternative config? 'YES' Is alternative config requiring other external elements? 'NO' - Back to Chain service elements (once all elements are delivered)		IN
S-BUS(N+1,J)	Service activated - For each externally sourced element (grouped by ICT-SP or cluster and identified by element ID)				BS
B-BUS(N)	Report "External service element activated" to E-SOF for service chaining				IN
S-BUS(N+1,J)	Activation failed (including element ID)				BS
B-BUS(N)	Record detail		Report "Activation Failed" Trigger SLA event to S-BUS(N)		IN
S-BUS(N)	Report "Activation Failed" Trigger SLA event to B-BUS(N-1)				BC
S-BUS(N)	Report "Activation Failed" Trigger SLA event to E-SOF(N)				IN
E-SOF(N)	Receives "Activation Failed" Trigger SLA event from S-BUS(N)		Identify Internal/External associated elements (element IDs). Send termination request for internal elements to I-SOF(N)		IN

B-BUS(N)	Identify external supplier per element triggered from E-SOF(N) (including Element IDs)		Send termination request per element		BS
B-BUS(N-1)	Request report per Service ID				BC
S-BUS(N)	Record Request				IN
E-SOF(N)	Identify Service Identify Internal and External elements		Request report for Internal elements from I-SOF(N)		IN
E-SOF(N)	Identify Service Identify Internal and External elements		Request report for external elements from S-BUS(N)		IN
B-BUS(N)	Identify supplier for each external element				IN
B-BUS(N)	Identify supplier for each external element		Request report per service ID		BS
S-BUS(N+1,J)	Report per Service ID (per request or scheduled) to B-BUS(N)				BS
B-BUS(N)	Receive Report Reconcile Record response - over to E-SOF(N)				IN
I-SOF(N)	Report per Service ID (per request or scheduled) to E-SOF(N)				IN
E-SOF(N)	Consolidate reports and create an ICT-SP(N)-to-End report				IN

S-BUS(N)	Record response and deviations from SLA. Reconcile		Report per service ID (per request or scheduled)		BC
Finance(N)	Rating and charges generation per service		Consumption related fees minus SLA violation credits Based on contract	BC	IN
Finance(N)	Invoice generation to S-BUS			IN	IN
S-BUS(N)	Invoice generation to S-BUS	Dispute 'NO'		IN	BC
S-BUS(N)	Invoice generation to S-BUS	Dispute 'YES'	Back to E-SOF for reconciliation	IN	IN
E-SOF(N)	Invoice generation to S-BUS	Dispute 'YES'	Reconciliation - Reached through negotiations with Customer		BC
E-SOF(N)	Invoice generation to S-BUS	Dispute 'YES'	Reconciliation - Reached through negotiations with Customer - Invoice generation for S-BUS(N)		BC
S-BUS(N)	Invoice generation to B-BUS	Dispute 'YES'	Reconciliation - Reached through negotiations with Customer - Invoice generation for B-BUS(N-1)		BC
B-BUS(N)	Stores utilization info and SLA performance info for all externally sourced elements	(external services information storage)			IN
B-BUS(N)	Stores utilization information and SLA performance info for all internally sourced elements	(internal services information storage)			IN
TBD(N)	Aggregated utilization and SLA information		Send to Finance(N)	IN	IN

B-BUS(N)	Stores utilization info and SLA performance info for all externally sourced elements	(external services information storage)		IN	IN
TBD(N)	Aggregated utilization and SLA information		Send to Finance(N)	IN	IN
B-BUS(N)	Stores utilization info and SLA performance info for all internally sourced elements	(internal services information storage)	Aggregated utilization and SLA information - SEND TO FINANCE	IN	IN
Finance(N)	Rating and charges generation per service		Consumption related fees minus SLA violation credits Based on contract	BS	IN
Finance(N)	Expected Invoice generation to TBD(N)				IN
TBD(N)	Receives Inbound invoice				BS
TBD(N)	Compare Inbound invoice to Expected invoice			IN+ BS	
TBD(N)	Compare Inbound invoice to Expected invoice	Dispute 'NO'	To Settlement		BS
TBD(N)	Compare Inbound invoice to Expected invoice	Dispute 'YES'	Reconciliation		BS
TBD(N)	Compare Inbound invoice to Expected invoice	Dispute 'YES'	Reconciliation > Compare Inbound invoice to Expected invoice	IN + BS	BS
TBD(N)	Compare Inbound invoice to Expected invoice	Dispute 'NO'	To Settlement		BS
Finance(N)	Signed invoice (Non-disputed or Reconciled)		Netting (optional)		BS

Finance(N)	Signed invoice (Non-disputed or Reconciled)		Payment - stable coin/token		BS
B-BUS(N-1)	Customer has complained of SLA violation		Service ID at fault		BC
S-BUS(N)	Record complaint			IN	IN
E-SOF(N)	Identify Faulty element			IN	IN
E-SOF(N)	Identify Faulty element				IN
I-SOF(N)	Identify Faulty element		Proactive monitoring has identified SLA violation	IN	IN
E-SOF(N)	Identify Faulty element	In flight 'YES'	Internal or external?		IN
E-SOF(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Send to B-BUS(N)		IN
B-BUS(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Report to respective supplier - SLA considerations		BS
S-BUS(N+1,J)	Identify Faulty element	In flight 'YES' - EXTERNAL	Outage of in- flight service needed		BS
B-BUS(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Record event. SLA considerations- to S-BUS(N)	IN	IN
S-BUS(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Coordinate Maintenance Outage		BC
B-BUS(N-1)	Identify Faulty element	In flight 'YES' - EXTERNAL	Outage of in-flight service needed		BC
S-BUS(N+1,J)	Identify Faulty element	In flight 'YES' - EXTERNAL	In-flight service Repaired		BS
B-BUS(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Record event. SLA considerations- to S-BUS(N)		BS
S-BUS(N)	Identify Faulty element	In flight 'YES' - EXTERNAL	Inform customer. Consider SLA Credit implications		BC

B-BUS(N-1)	Identify Faulty element	In flight 'YES' - EXTERNAL	In-flight service Repaired		BC
E-SOF(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Send to I-SOF(N)		IN
I-SOF(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Is repair without outage possible?		IN
I-SOF(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Is repair without outage possible? YES: - Repair fault. Advise B-BUS(N)		IN
S-BUS(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Is repair without outage possible? YES: Inform customer. Consider SLA credit implications		BC
B-BUS(N-1)	Identify Faulty element	In flight 'YES' - INTERNAL	Is repair without outage possible? YES: In-flight service repaired		BC
I-SOF(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Is repair without outage possible? NO - advise S-BUS(N)		IN
S-BUS(N)	Identify Faulty element	In flight 'YES' - INTERNAL	Coordinate maintenance outage - advise B-BUS(N-1)		BC
B-BUS(N-1)	Identify Faulty element	In flight 'YES' - INTERNAL	Outage in-flight service needed		BC
E-SOF(N)	Identify Faulty element	In flight 'NO' - INTERNAL	Repair by I-SOF		IN
E-SOF(N)	Identify Faulty element	In flight 'NO' - EXTERNAL	Send to B-BUS(N)		IN
B-BUS(N)	Identify Faulty element	In flight 'NO' - EXTERNAL	Report to respective supplier - SLA considerations		BS

Table 4 - Data Management per workflow

9 Summary

The CBAN Data-on-Demand Reference architecture is an extension of the MEF LSO Reference Architecture that provides commercial and operational layers, allowing implementation of automated data-on-demand services across a chain of wholesale ICT-SP operators. Through adoption of a unified information modelling approach, unified processes and unified service definitions, ICT-SPs can unleash the commercial potential of on-demand services and benefit from new revenue streams from existing network infrastructure.

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Appendix A MVP Data on Demand White Paper

Abstract

CBAN (Communications Business Automation Network) has initiated a project outlining the commercial and operational aspects of a blockchain-based BSS/OSS automation platform for Data-on-Demand services.

The project expands the capabilities of the MEF LSO Reference Architecture and adds a commercial layer to it. The project also expands the scope of MEF LSO to the entire ICT-SP community, inclusive of Cloud and 5G operators.

At the core of this project lies the assumption that all ICT-SPs adopt a common information modelling approach and a common approach for inter-domain federation, allowing automation of inter-domain processes without compromise of internal policies and processes. The main benefit of automation of data service lifecycle is a significant increase in speed of ordering, delivering and settlement of inter-domain data services, as demonstrated in multiple PoCs, yielding new revenue streams from existing infrastructure and generating additional value in the wholesale telecom landscape.

Introduction

The wholesale telecom landscape is suffering commoditisation as a result of migration of services from managed platforms to best-effort platforms. However the migration to best-effort platforms introduces performance and security concerns that are hard to solve. One of the main reasons for the migration of services to best-effort protocols, albeit the compromise on performance and security, is the inability of managed networks to respond quick enough to the ever changing demand. Typical lead times for managed service activation ranges from minutes (when a single domain is involved) to months (when multiple domains are involved), while lead times for activation of a best-effort service can be as quick as milliseconds.

This project demonstrates an approach that can bring the wholesale telecom managed data services to offer lead times significantly closer to those of best-effort networks without compromising performance and security, thus offering the wholesale telecom industry new revenue streams in place of commoditization.

ICT-SPs handle Data

ICT-SPs include Cloud operators, Mobile operators, Telecom operators and any other entity in the ICT space that handles data in one or more ways.

Data handling can be categorised under three main areas:

- Transport Data through Space - Connectivity
- Transport Data through Time - Storage

- Manipulate Data - Compute / NFV (see GSMA & LFN [Common NFVI Telco Task Force -CNTT](#))

Applications use one or more of the above data handling areas to generate value the user.

As a simple example we can take an enterprise using an E-LINE to connect its headquarters with a remote office. This example obviously includes connectivity, but it may also include a firewall or an SD-WAN device that manipulate and prioritise data flows.

A more complex example would be a video conferencing facility that includes connectivity between end-users and an MCU (Media Control Unit), data processing (at the MCU and at the edge devices) allowing video flow and user identification, and possibly also storage services where user information is stored and call recordings can be found.

It is more often than not that such services traverse multiple network domains operated by different ICT-SPs. Such domains may represent geographical coverage, specific network technologies (e.g. wireless) or specific data functionalities (e.g. storage or processing).

The operational model of an automated inter-domain service assumes a federation of multiple operator/carrier networks enabling delivery of services across multiple operator domains. Operators in that context may be legacy telcos, MNOs, Cloud providers, Data-Centre operators and any other operational entities that may be involved in delivery of end-to-end ICT services.

The services in focus are on-demand type services where *on-demand-type* means services that are expected to be activated, operated, billed and settled with immediate effect, thus are expected to be based on pre-existing and pre-on-boarded facilities and interconnects. This is not limiting the scope of such platform to on-demand services only, as services that require manual installation can be catered through timeline management during the quote and implementation phases. The aim is to automate the entire lifecycle of services and eliminate, or at least minimise, manual tasks.

Impact of this problem

There are ~3000 ICT Service Provides worldwide. Each using a BSS/OSS of some sort. Some are home grown, others are outsourced and some are a mix of both. BSS/OSS platforms are typically extremely complex and based on multiple sub-platforms with high levels of integration and interdependency. As a result ICT-SPs are typically reluctant to modify their existing platforms thus the feasibility of migration of existing BSS/OSS platform to adopt new information models that will allow inter-carrier interoperability is considered low.

Having said that - Based on numerous PoCs there are positive indications that a DLT based Federated BSS/OSS platform is feasible, though it requires high levels of alignment of Processes, Information Models and Service Specifications across all stakeholders. Thus the proposed architecture suggests a parallel build of an automated platform that will be interoperable with legacy platforms, and gradual migration of services from the legacy platform to the automated platform. Such migration may take years to complete depending on the environment and clientele.

Business overview

ICT-SPs live in a state of *mutual-suspicion* and in an environment of “*coopetition*” where ICT-SPs **both compete and cooperate** with each other. On one hand ICT-SPs compete with each other by trying to win the consumer or wholesale business. On the other hand, ICT-SPs often rely on complementing their own portfolio with certain elements of service that they acquire from their competitors. This could be geographical coverage of a certain territory, compute or storage resources or specific applications or security features not available through the ICT-SP’s own resources.

Management of such supply chain in an environment of mutual-suspicion and coopetition eliminates the option of using a centralized intermediator. It is unlikely that ICT-SPs will be willing to offer a third-party “honest broker” visibility and management of their resources, be that a competing third party or a neutral one. The few attempts to transact through such brokers have created operational dependency that did not scale well and had negative effects on profits and margins.

Thus – the wholesale ICT-SP industry is based on a partial mesh of bilateral agreements between ICT-SPs transacting in an equal-level playing field where no hierarchy exists, regardless of size or coverage. Wholesale relationship is always bilateral, on a one-on-one level. A service may span across multiple ICT-SPs but is implemented through a chain (that may be forked and forked again) of bilateral relations between pairs of ICT-SPs.

Being a distributed and non-hierarchical ledger, DLT is a good fit for wholesale ICT-SP wholesale supply chain scenarios even when the ultimate beneficiary is an individual subscriber and the supply chain includes operators, cloud, application developers, on-line stores, POS and banks. DLT allows all stakeholders to be linked together to ensure trusted transactions take place and trusted information is correctly stored and retrieved by all parties.

Current environment

The current ICT-SP environment consists of operational silos. Each ICT-SP has developed its own operational silo where it performs its sales activities and manages the lifecycle of services delivered through its platforms. The level of automation in those operational silos varies from ICT-SP to another. Certain ICT-SPs still use manual processes, some of which still include paperwork, faxes, forms and manual entry and transfer of information from one form/system to another. Other ICT-SPs have established certain levels of integration and automation where information is transmitted electronically across systems using APIs or other digital methods. Some ICT-SPs have even exposed APIs through which their customer (be that an individual consumer or another ICT-SP) can order and activate certain services. Combining and externally exposed API with automation of internal tasks allows an ICT-SP to significantly reduce timelines and expedite revenue generation. The number of ICT-SPs offering such APIs is currently small and the APIs are inconsistent across the industry, generating IT overheads and limiting functionality.

Some of the components and ICT-SP’s automation platforms include the BSS/OSS layers (Business and Orchestration), and in many cases automation also includes the NMS and EMS layers (Network Management and Element Management Systems). Through use of SDN and NFV - BSS/OSS platforms can control and configure the network resources through software, eliminating the need for a human to manually configure devices and management platforms by use of CLI or a GUI. Through NFV ICT-SPs can also reduce (and in some cases eliminate) truck rolls and physical installation of devices at customer sites. Once an NFV enabled CPE is installed at a location, it can be configured from remote allowing activation of features without having to dispatch a technician for a site visit. ICT-SPs vary in the level of penetration of such automation to their network and capabilities.

Adding to that an increased use of Artificial Intelligence (AI) that allows smart alerts and automation of activities based on events in real (or near real) time.

Current BSS/OSS, as well as NMS and EMS platforms show a mix of outsourced and in-house development. It is rare to find two ICT-SPs using identical BSS/OSS platforms. The operational silos are tailored for each and every ICT-SPs unique environment, product portfolio, choice of gear and software, geography, regulation and competitive landscape.

Pain points

While automation of intra-silo/intra-ICT-SP activity already exists in certain places, automation of inter-silo/inter-ICT-SP activities is still in its infancy. Cloud based services are bit more advanced and offer automated life cycle management of services deployed on their cloud infrastructure, however each cloud ICT-SP offers their own unique set of APIs and controls to which all its consumers must align. An ICT-SP that wants to establish automation of services with multiple Cloud-SPs will have to develop dedicated APIs for each and every Cloud SP. This can be managed as the number of Cloud SPs currently operating in the market is relatively small (around 10) compared to the total number of ICT-SPs (around 3000). Attempts to get all Cloud-SPs to use a unified set of APIs have so far failed due to lack of cooperation/interest on behalf of said ICT-SPs.

When it comes to other ICT-SPs, those coming from the Telco and Mobile background - Automation is focussed primarily on internal processes, and little or no attention had been given to automation of inter-SP operations. When an ICT-SP develops an automation platform it will typically allow automation of service delivery on its own network resources (connectivity, compute or storage) and possibly an extension of services into Cloud-SPs with which the ICT-SP has established automation. Extension of services into other, non-Cloud, ICT-SPs is still handled manually. Certain non-Cloud-ICT-SPs are offering APIs that offer partial life-cycle management of services on their network (inquiry, ordering, perforce reporting, change management, billing) however - those APIs are following different or no standards and require tailoring of APIs or API gateways between each pair of ICT-SPs. While such tailoring is manageable when 10 Cloud SPs are involved, it becomes difficult or impossible to manage and scale when 3000 ICT-SPs are involved, each offering its own flavor of products, Data Models and processes.

As a result of continued use of manual transactions and operations, timelines for delivery of services stretch over weeks and months. Such timelines do not meet the needs of today's applications that require an agile network that can response to demand in real (or near real) time. while it may take a few minutes to activate a compute or storage resource on a Cloud-SP data-center, it may take weeks to establish managed connectivity from a customer site to that Cloud-SP resource. Most applications requiring connectivity to Cloud-SP resources resort to the always-on public internet, which does not offer manageability: No guaranteed performance and no security.

The slow operations of ICT-SPs on one side, and the ever growing need for additional unmanaged public-internet bandwidth have become a deadlock. On one side - Managed services revenues are declining as such services can not cope with the agility required by today’s applications. On the other side - more bandwidth, storage and compute resources are installed, in many cases under-utilised, to support growth of the low-revenue and low margin public-internet infrastructure.

An additional pain point is the slow and laborious nature of today's manual methods that results in high per-transaction costs. Considering future services, such as IoT, that generate large volume of transactions, most of which associated with very low commercial value, the existing high per-transaction processing costs render such platforms as commercially non-viable.

Project scope and deliverables

In 2016 MEF Forum has published the LSO (lifecycle service orchestration) Reference Architecture (“RA”) [6] that defines an abstract architecture where service to a consumer is delivered through a chain of wholesale SPs. The LSO RA has defined functional entities such as a Business Functions (“BUS”) that reflects the BSS, an Orchestration Function (“SOF”) that reflects the OSS and additional Network and Element Management functions. MEF has also defined Interface-Reference-Points (“IRP”) through which said functional entities exchange technical, operational and commercial information. The purpose of this document is to extend the MEF LSO RA and define an abstract commercial and operational architecture that refers to a single ICT operator but must be considered in the context of it being one link in an automated supply-chain of multiple operators. The BSS/OSS functionality of said RA represents the BUS and SOF functional elements in the LSO RA and adds a commercial and operational layer to it.

Long Term scope

Certain elements of the solution are currently under development in other SDOs and organisations. Those include:

- Unified IMs
- Processes
- Architecture (commercial and technical)
- Service Specifications

It may take years to complete some of those elements thus this document is using abstractions in places where the ICT industry still lacks definitions or alignment. Every attempt was made to offer abstractions that are agnostic to choice of Information Models, Data Models, APIs or service definitions, but an inherent assumption and requirement for the proposed architecture is that all participants adopt a uniform information model, uniform service definitions and uniform process flows. While this may be very complex to achieve using the legacy BSS/OSS platforms, it is a plausible task when platforms that follow agile development are concerned.

Short Term Scope

In the short term the document focuses on a blockchain-based Operational and Commercial framework (agnostic to service type/technology) demonstrating generation of commercial value through wholesale trading of data services. The document includes an enhancement to the LSO RA, per-lifecycle-stage process flow, and a data repository and management requirements from the supporting blockchain platforms.

Potential benefits

The potential benefits of automation can be grouped under the following categories:

Cost Reduction

Automation can reduce manual labor, as well as reduce complexity.

Automation can facilitate system integration and reduce total number of platforms in an ICT-SP environment.

Acceleration

Automation can reduce the time certain operations take thus yield results faster. This may be seen as faster time-to-market, faster order-to-fulfilment timelines, as well as shorter fault identification and repair and shorter settlement and reconciliation timelines.

As a side benefit - reduction in timelines may result in reduction in costs and increase in operational efficiency.

New Revenue Streams

Acceleration of service lifecycle stages can yield new revenue streams by being able to offer customers services that were impossible to deliver using manual processes. On-demand type of services, that require resources for short durations, can be commercially offered once the underlying infrastructure is able to perform the lifecycle operations fast enough to match the duration of the requested service. It would make little (or no) commercial and operational sense to go through a three-month long activation process for a one-day service. It would make sense, though, to go through a 15 minute long activation process for such one-day long service, a seconds long activation process for a minutes long service and a sub-second activation process for a seconds-long service.

Once the service life-cycle operations accelerate to speeds that are relevant for the services rendered - a techno-commercial eco-system can be developed that allows selling and consumption of such services.

Data on Demand Reference Architecture

The MEF LSO Reference Architecture (MEF 55) represents a federation of ICT-SPs, the internal functional elements and the reference points between them. Specifically the LSO Reference Architecture (LSO RA) decomposes the ICT-SP functionality into four functional entities: The Business Apps functional element (BUS), The Service Orchestration Function functional element

(SOF), the Network Management functional element (NMS) and the Element Management functional element (EMS). MEF has also defined several LSO Interface Reference Points (“IRP”s) through which functional elements/entities exchange information with other functional elements/entities during the lifecycle of a service. Those LSO IRPs are divided into “North-South” IRPs representing internal flows of information between layers that belong to the same operational entity, and “East-West” IRPs representing external flows of information between similar functional elements that belong to different operational or commercial entities. The focus of this document is Business and Orchestration so it does not discuss the Network and Element Management layers. The goal is to define a Business and Orchestration framework that is agnostic to underlying Network and Element layers, which will be represented through product, service and element catalogues and inventory systems.

Where this architecture differs from the LSO RA is that it:

1. Adds a multi-domain commercial framework.
2. Restructures the Business functional element (LSO BUS) by breaking it to a Selling sub-functionality and a Buying sub-functionality.
3. Restructures the Orchestration functional element (LSO SOF) by breaking it to an End-to-End Orchestration sub-functionality and an Internal Orchestration sub-functionality.

The Internal Orchestration sub-functionality is equivalent to the existing SOF functionality in MEF-55. It is also noted that existing MEF work is in the process of extending this sub-functionality by adding additional service types (e.g. Cloud) and adding a multi-layer orchestration functionality for ICT-SPs with complex and layered architectures that require hierarchical orchestration within a single ICT-SP domain.

An additional difference from the MEF LSO RA is the elimination of the Cantata, Allegro and Interlude IRPs and collapse of them all into a single east-west IRP, namely Sonata. The reasons behind that are the following:

1. Considering a chain of ICT entities (consumers and ICT-SPs), Cantata and Sonata convey the same types of information with the difference being that MEF Cantata represents information exchange between an end-customer and an ICT-SP, and MEF Sonata represents information exchange between two ICT-SPs. Since the process within an ICT-SP will be the same regardless if the eastbound neighbor is an end-customer or another ICT-SP, there is no difference, for the purpose of this document, between the two. A Cantata IRP can be implemented as a Sonata IRP. There are scenarios where certain differences exist (e.g. provisioning) and those are detailed case by case.
2. Interlude and Allegro represent information exchange between the Orchestration layers of entities. It was designed with the mindset of a subset of Sonata that does not contain commercial information. The fact of the matter is that there is hardly any east-west information exchange between entities that does not, potentially, have commercial implication. As a result the reference architecture used in this document eliminates the Interlude/Allegro interfaces and as described in the below sections - funnels all east-west transactions between the buying and selling sub-functionalities through the Sonata IRP.

The following diagram presents an abstract flow of an inquiry through a chain of ICT-SPs as described above.

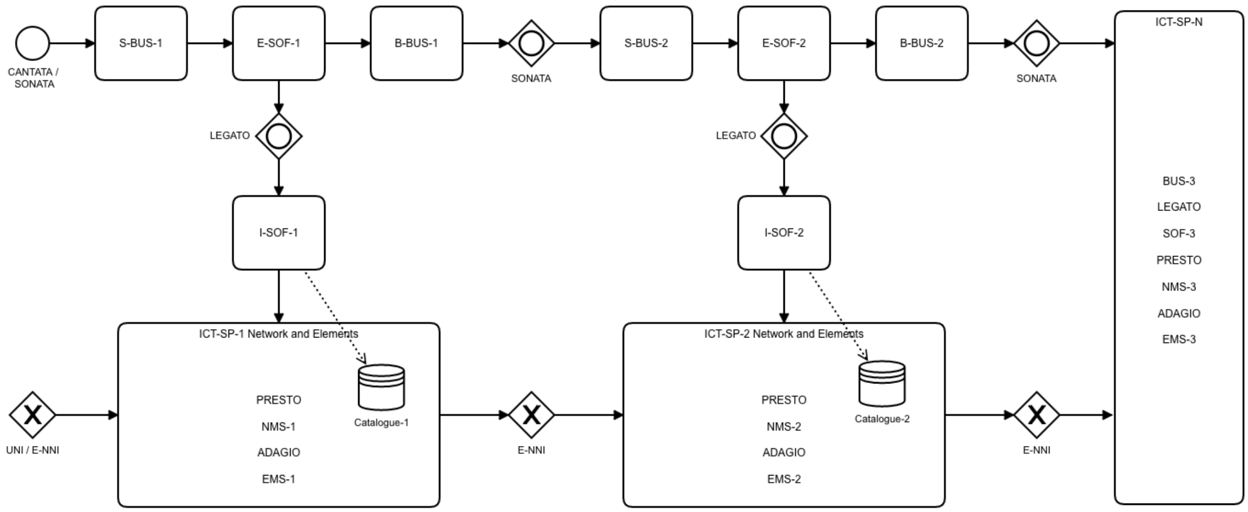

Figure 10-1 Data on Demand Reference Architecture

Note: The I-SOF-[x] elements in the diagram and the elements below them are depicted for reference and clarity of context, but are out of scope of this project.

While the above diagram provides context, the below diagram displays the functionalities of an ICT-SP (N) in a chain of ICT-SPs. Included in the diagram, for clarity, are the Buying functionality (B-BUS) of ICT-SP (N-1) to which ICT-SP (N) sells the service, and the Selling functionality (S-BUS) of ICT-SP (N+1) from which ICT-SP (N) sources elements of service it cannot fulfil through its own resources.

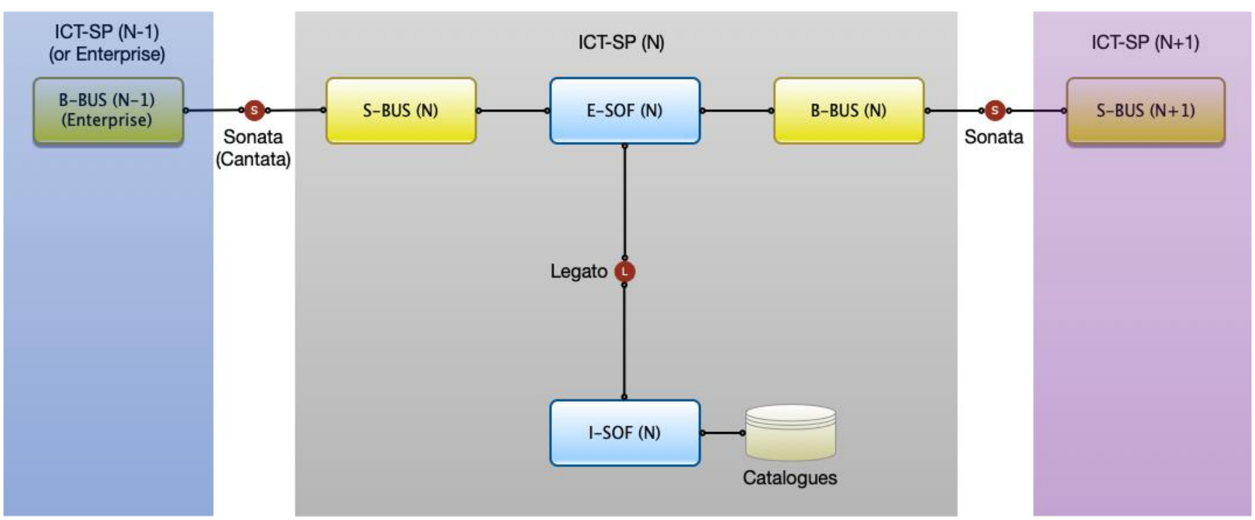

Figure 10-2 - Reference Architecture of an ICT-SP wholesale supply chain

The B-BUS of ICT-SP (N) may initiate requests with the S-BUSes of more than one ICT-SP. In such case the S-BUSes of those ICT-SPs will be named S-BUS (N+1,J), S-BUS (N+1, J+1) etc. The following diagram depicts this scenario.

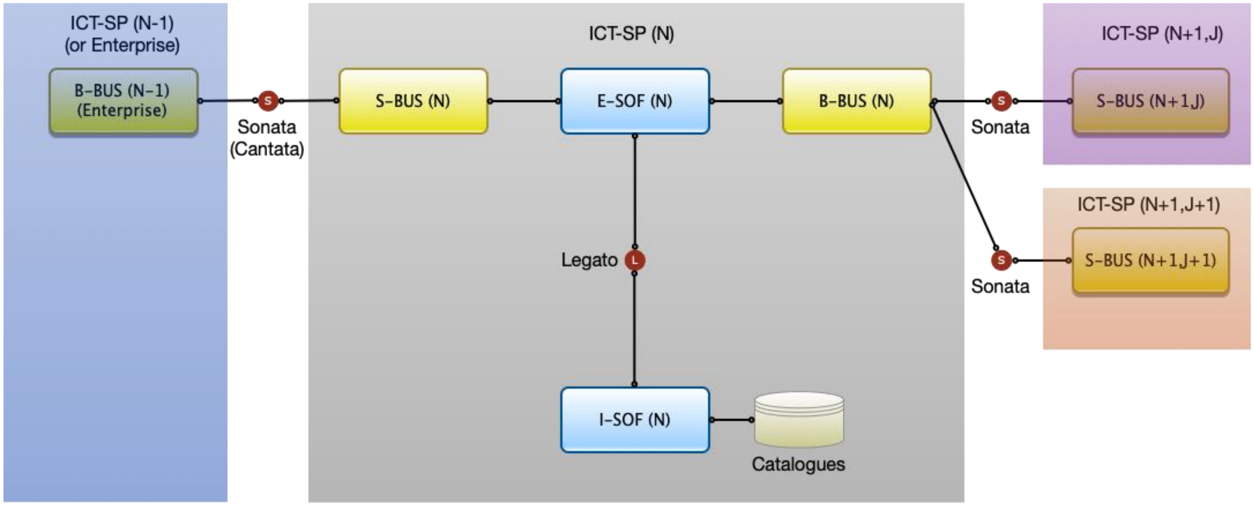

Figure 10-3 - Reference Architecture of an ICT-SP wholesale supply chain with multiple suppliers

The Added Value of using DLT

One question that immediately comes to mind would be: Why would we need blockchain for that? Can't we just use traditional ledgers?

The answer is evolved. Yes, we could probably get away without blockchain. That is likely the case for most blockchain based applications out there. However - the use of blockchain adds value in multiple aspects:

- Commercial Netting & Settlement
- Dynamic commercial arrangements among CT-SPs acting as peers in a supply chain, without the need of an external 3rd party.
- Bilateral transparency between partners while retaining commercial confidence of sensitive information.
- Reputation management (hiding actual identity across a supply chain).
- Real-time inventory / prevent "double spend/commit" on resources.
- Performance monitoring and reconciliation per the terms of a Service Level Agreement.
- Transparency of Order/Service/Billing status.
- Shared Catalogues (full or partial sharing).
- Use of Smart Contracts to calculate mark-up/credit etc.
- Smart Contracts can provide a level of real-time automation by transparently handling a number of commercial contingencies.

Requirements from the DLT layer

The DLT layer must

1. Support bilateral contracts and be able to transact bilateral transactions at certain rates.
2. Support Multilateral contracts that may be constructed of multiple chains that are synchronized in a manner that provides accuracy down to certain intervals and must support the following reputation management requirements:

  1. SLA reputation
  2. Payment and financial stability reputation

3. Appear agnostic to overlaying applications.

Abstraction and Functional Elements

The following diagram represents the required abstraction levels between functional elements where MVP(X/Y) represent data-on-demand applications such as E-Line, Video-Conference etc.:

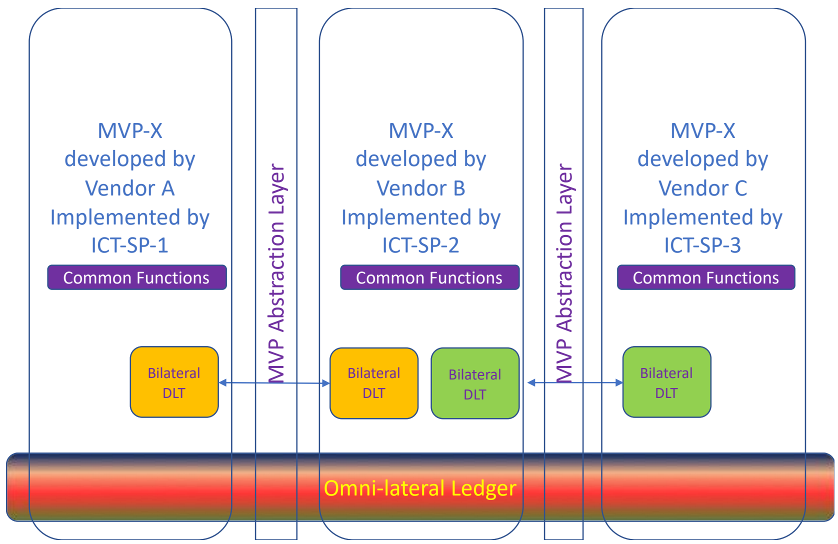

Figure 10-4 - MVP Abstraction Architecture - Phase 1

During Phase 1 vendors will provide the full stack (MVP, Common Functions, DLT) and offer support of a minimum of two DLT types.
On Phase 2 the stack will be further refined allowing vendors to deliver MVPs, Common Functions and Ledger compatibility separate from each other as well as abstract elements from within the MVPs. This approach opens up the eco-system to additional vendors specializing in specific layers of the stack or specific functions within the workflows.

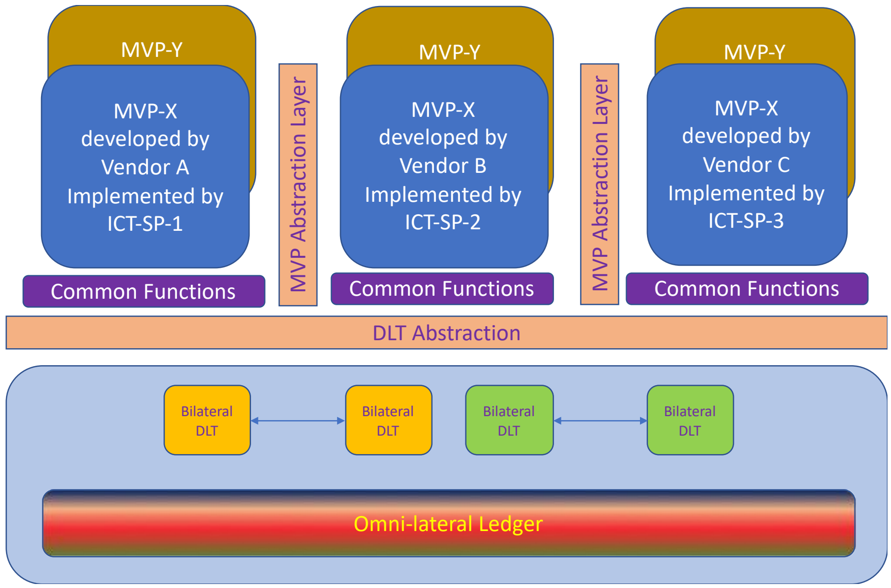

Figure 10-5 - DLT and MVP Abstraction Architecture - Phase 2

Summary

The CBAN Data-on-Demand Reference architecture is an extension of the MEF LSO Reference Architecture that provides commercial and operational layers allowing implementation of automated data-on-demand services across a chain of wholesale ICT-SP operators. Through adoption of a unified information modelling approach, unified processes and unified service definitions, ICT-SPs can unleash the commercial potential of on-demand services and benefit from new revenue streams from existing network infrastructure.